High performance mutual capacitance touch controller

1. INTRODUCTION

The CST328 using high-speed MCU core and embedded DSP circuit. Combined with its own fast mutual capacitance detecting technology, it supports single-layer/multi-layer modules and multiple patterns, and it using high-voltage drive above 10V to achieve ultra-high sensitivity and extremely low standby power consumption, and to achieve high performance and real multi-touch (with pressure detection).

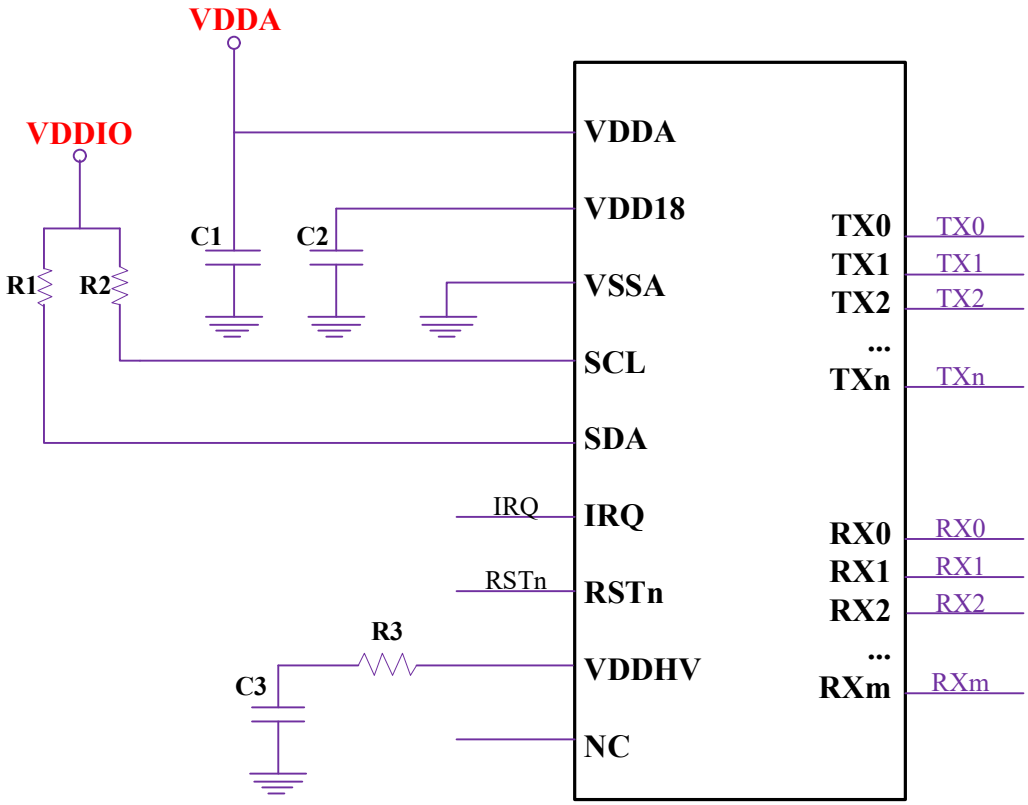
2. FEATRUES

- Fast capacitance detection circuit and high performance DSP module
  - Detecting self capacitance and mutual capacitance;
  - High voltage drive to realize high sensitivity and SNR;
  - Supports passive capacitance touch pen;
  - Supports standby gesture wake-up;
  - Supports On-line Programming;
  - Built-in watchdog;
  - Supports Multiple keys;
- Performance specification
  - Typical refresh rate is 120Hz;
  - Water proof，thumb and palm proof;
  - Typical power consumption in dynamic mode : 2.8mA;
  - Typical power consumption in monitor mode : 300uA;
  - Typical power consumption in sleep mode : 50uA.
- Capacitive screen support
  - Up to 28 drive/sensing channels and TX/RX are multiplexing;
  - Floating and pulling down channel are supported;
  - Supports traditional DITO and SITO sensor patterns;
  - Automatic module parameters calibration is supported, maximum support impedance is up to 120k;
  - Supported cover Lens thickness: glass<=2mm acrylic<=1mm;
- Communication interface
  - I2C master/slave mode are supported, data rate is configurable from 10Khz to 1Mhz;
  - GPIOs support a variety mode including internal resistor pull up mode;
  - Internal 1.8V LDO, configurable IO voltage level is compatible with 1.8V/VDDA.
  - Output voltage of VDD18 is 1.8V, output voltage of VDDHV is 6~12V.
- Power supply
  - Single-supply operation: 2.7V ~ 3.6V, ripple <= 50mv;
  - Few peripheral components needed.
- Package type: QFN40 5mm*5mm.

3. APPLICATIONS

Cell phone, tablet PC, notebook, touch pad.

4. TYPICAL APPLICATION



C1: 2.2uF/10V

C2: 0.1uF ~ 1uF/10V

C3: 10nF ~ 100nF/16V

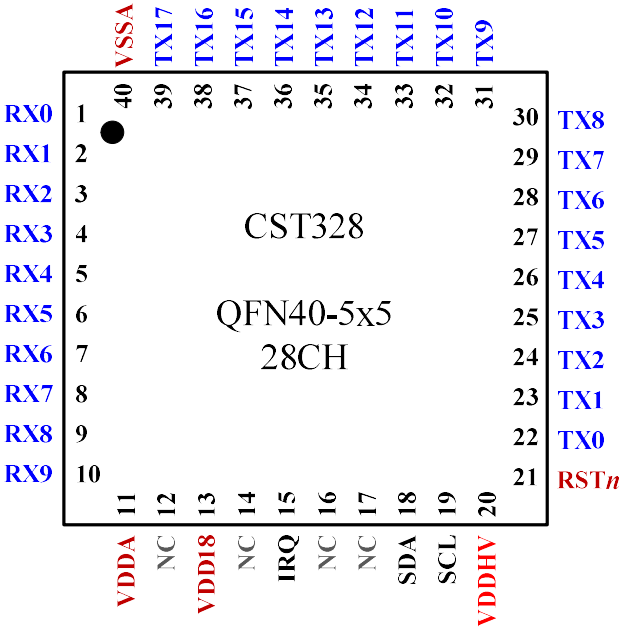
R3: 200Ω

VDDIO: VDDA or VDD18

R1/R2: External pull up resistor or internal 5K pull up resistor

Sensor ID: Floating or connecting unused TX/ RX to GND to assign an ID

5. PIN CONFIGURATIONS



6. PIN FUNCTION DESCRIPTIONS

PIN NO.	NAME	TYPE	DESCRIPTION	PIN	NAME	TYPE	DESCRIPTION
1	RX0	I/O	Rx or Tx channel	21	RST*n*	I	Active-low
2	RX1	I/O	Rx or Tx channel	22	TX0	I/O	Tx or Rx channel
3	RX2	I/O	Rx or Tx channel	23	TX1	I/O	Tx or Rx channel
4	RX3	I/O	Rx or Tx channel	24	TX2	I/O	Tx or Rx channel
5	RX4	I/O	Rx or Tx channel	25	TX3	I/O	Tx or Rx channel
6	RX5	I/O	Rx or Tx channel	26	TX4	I/O	Tx or Rx channel
7	RX6	I/O	Rx or Tx channel	27	TX5	I/O	Tx or Rx channel
8	RX7	I/O	Rx or Tx channel	28	TX6	I/O	Tx or Rx channel
9	RX8	I/O	Rx or Tx channel	29	TX7	I/O	Tx or Rx channel
10	RX9	I/O	Rx or Tx channel	30	TX8	I/O	Tx or Rx channel
11	VDDA	PWR/I	2.7~3.6V，2.2uF	31	TX9	I/O	Tx or Rx channel
12	NC	NC	NC	32	TX10	I/O	Tx or Rx channel
13	VDD18	PWR/O	1.8V，0.1~1.0uF	33	TX11	I/O	Tx or Rx channel
14	NC	NC	NC	34	TX12	I/O	Tx or Rx channel
15	IRQ	I/O	INT	35	TX13	I/O	Tx or Rx channel
16	NC	NC	NC	36	TX14	I/O	Tx or Rx channel

17	NC	NC	NC	37	TX15	I/O	Tx or Rx channel
18	SDA	I/O	I2C SDA	38	TX16	I/O	Tx or Rx channel
19	SCL	I/O	I2C SCL	39	TX17	I/O	Tx or Rx channel
20	VDDHV	PWR/O	max12V，10~100nF	40	VSSA	GND	VSSA

O *Output Only*

I/O *Input And Output*

7. ORDERING GUIDE

料号	封装	表面印字	包装
CST328	QFN40-5*5(P0.40 T0.55)	方向点 +LOGO+CST328+PO	5000/盘，编带出货

8. ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min	Typical	Max	Unit	Comments
Operating VDDA	Vdd	2.7	3.0	3.6	V	
Ripple	Vrip	-	-	50	mV	
Analog I/O Tolerance	Vioa	-0.3	-	12	V	
Digital I/O Tolerance	Viod	-0.3	-	3.6	V	
I/O current Tolerance	Iiom	-15	-	15	mA	
Operating Temperature Range	Topr	-40	+25	+85	˚C	
Storage Temperature Range	Tstg	-60	-	+125	˚C	
Operating Humidity Range	Hopr	-	-	95	%	
ESD HBM	ESD	3000	-	-	V	Human Body Model ESD
ESD MM	ESD	200	-	-	V	Machine Mode
Latch-up Current	LU	-	-	200	mA	

9. ELECTRICAL CHARACTERISTICS

9.1 DC electrical characteristics

Ta = 25 ˚C, VDDA = 2.8V.

Parameter	Symbol	Min	Typical	Max	Unit
LOW-level output voltage	Vol	-	-	0.3*IOVCC	V
HIGH-level output voltage	Voh	0.7*IOVCC	-	-	V

LOW-level input voltage	Vil	-0.3	-	0.3*IOVCC	V
HIGH-level input voltage	Vih	0.7*IOVCC	-	IOVCC	V
Current（Dynamic）	Iopr	-	2.8	-	mA
Current（Monitor）	Imon	-	300	-	uA
Current（Standby）	Ista	-	300	-	uA
Current（Sleep）	Islp	-	50	-	uA

9.2 AC electrical characteristics

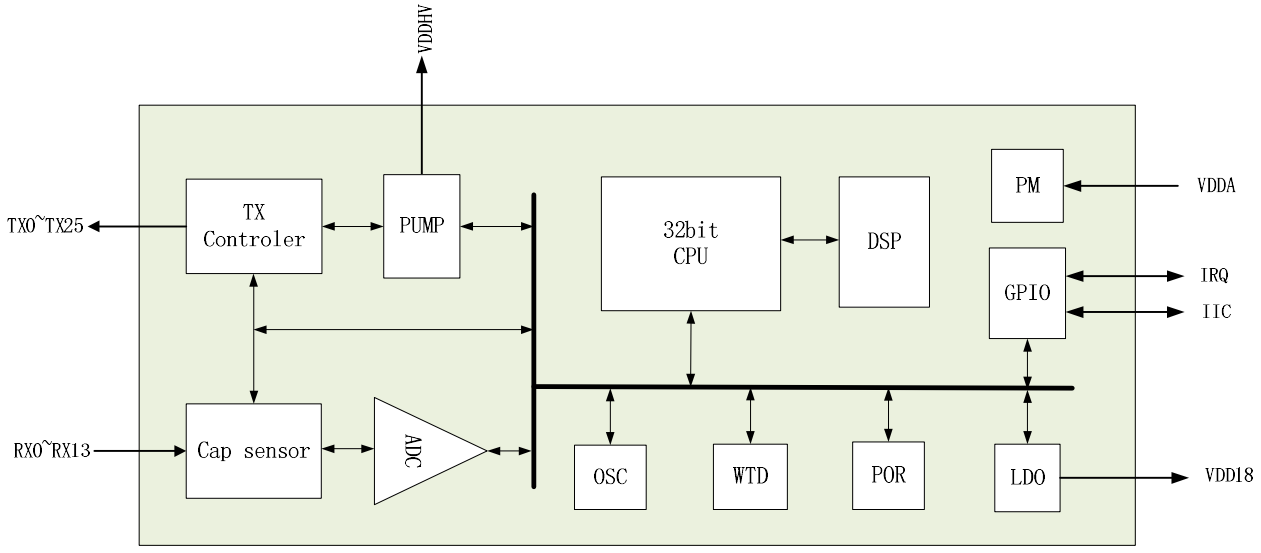
Ta = 25 °C, VDDA = 2.8V.

Parameter	Symbol	Min	Typical	Max	Unit
TX Output Frequency	ftx	-	-	350	KHz
TX Output Voltage	Vtx	-	-	12	V
RX Input Voltage	Vrx	-	1.4	-	V

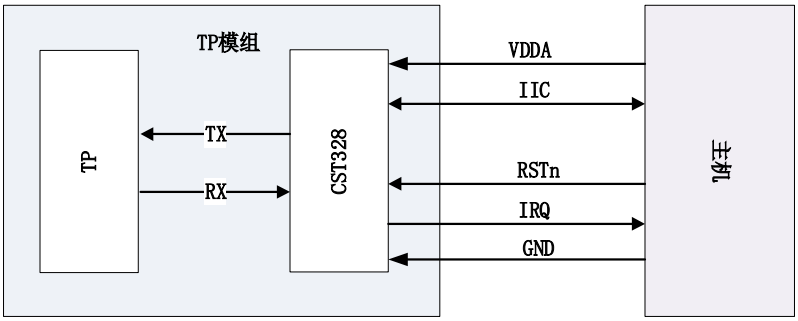
10. FUNCTION DESCRIPTION

The voltage of TX Drive channel is above 10V, compare to traditional low voltage drive touch controller, CST328 provide higher performance with Higher SNR and High sensitivity. Meanwhile, internal Self Capacitance/Mutual Capacitance detecting module works with intelligent scanning algorithm to realize rapid response, excellent water proof capability, noise suppression capability and low power consumption.

Block Diagram：



10.1 Interface For Host



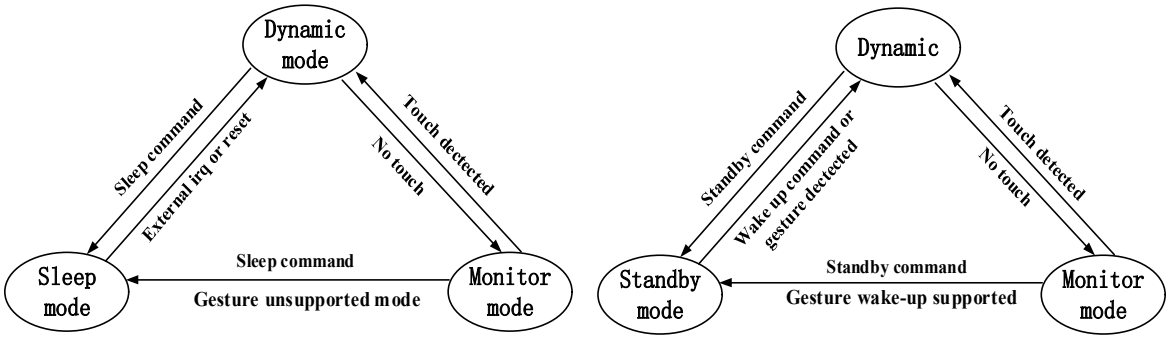
Interface between CST328 and host includes IIC, IRQ, RSTn and VDDA. Interface between CST328 and TP includes TX and RX.

VDDA: Operating voltage of CST328.

SCL and SDA: Serial communication pins of I2C bus, Host: Master，CST328: Slave.

IRQ: Interrupt signal, it is a GPIO, IRQ is used by CST328 to notify host to read when data such as touch data or gesture data is prepared.

10.2 WORK MODE



- Dynamic Mode

  When there are frequent touch operations, the chip will be in this mode; In this mode, the touch chip can quickly perform intelligent scanning on the touch screen, detect the touch in time and report it to the host computer;

- Monitor Mode

  In this mode, when the touch screen time out without touch action, the chip will automatically switch to the monitor mode; In this mode, the touch chip detects the possible touch action through mutual capacitance scanning at a low frequency, and quickly switches to the active mode;

- Standby Mode

  After receiving the standby command, the chip will be in this mode; In this mode, the touch screen is scanned by the touch chip at a low frequency. After matching the wake-up gesture, the touch screen enters into the active mode. Meanwhile, the host is awakened by IRQ pin. You can also switch to active mode with the wake command;

- Sleep Mode

  In this mode, the touch chip is in a deep sleep state to minimize power consumption, and can be switched to active mode by wake-up command.

10.3 Channel/Node Configuration

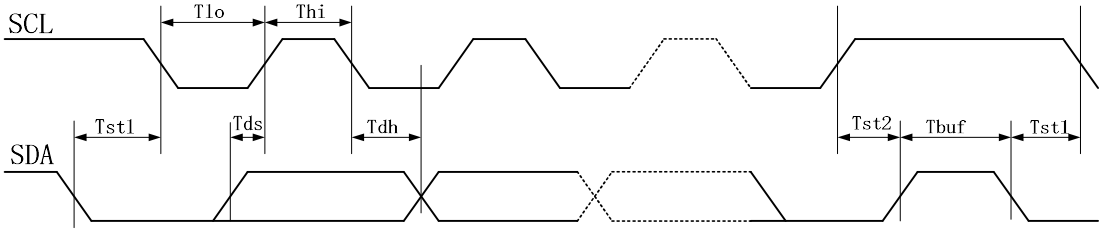
The CST328 multi-touch controller provides up to 28 channels, and each channel can be flexibly configured between the drive/sensing purposes. Each channel supports mutual capacitance scanning.

When assigning drive/sensing pins, Strongly recommended to select continuously arranged pins.

The range of mutual capacitance that each node can support is: 0.5pf ~ 20pF (assuming the driving voltage is 10V);

10.4 I2C Bus

CST328 supports standard I2C bus protocol, data rate is configurable from 10Khz~1Mhz, SCL and SDA pin can be flexibly configured as open drain mode or internal resistor pull up mode.



Description	Symbol	Fast Mode		HS Mode		Unit
		Min	Max	Min	Max	
SCL clock frequency	Fscl	0	400	0	1000	kHz
SCL hold time for START condition	Tst1	0.6	-	0.5	-	us
LOW period of SCL	Tlo	1.3	-	0.26	-	us
HIGH period of SCL	Thi	0.6	-	0.26	-	us
SDA setup time	Tds	0.1	-	0.05	-	us
SDA hold time	Tdh	0	0.9	0	0.9	ns
SCL setup time for STOP condition	Tst2	0.6	-	0.26	-	us
Ready time between STOP and START	Tbuf	20	-	20	-	us

CST328 is always a slave, host initiates a START signal by pulling down SDA when SCL is high.

CST328 checks address(configurable, default value is 0x34/0x35) after START signal, CST328 set SDA as output pin and pull it down in 9th cycle if the address matched, 9 bits data(8 bits payload and 1 bit ACK or NAC) will be sent through SDA in 9 cycles.

STOP signal is also sent by host, it is a STOP signal that SDA is released and pulled up when SCL is high, that means a single data transfer completed.

a. Host write, data format：

S	Slave Address[7bit]	W[1bit]	ACK	DATA[8bit]	ACK	...	DATA[8bit]	ACK/ NACK	P

b. Host read, data format：

S	Slave Address[7bit]	R[1bit]	ACK	DATA[8bit]	ACK	...	DATA[8bit]	NACK	P

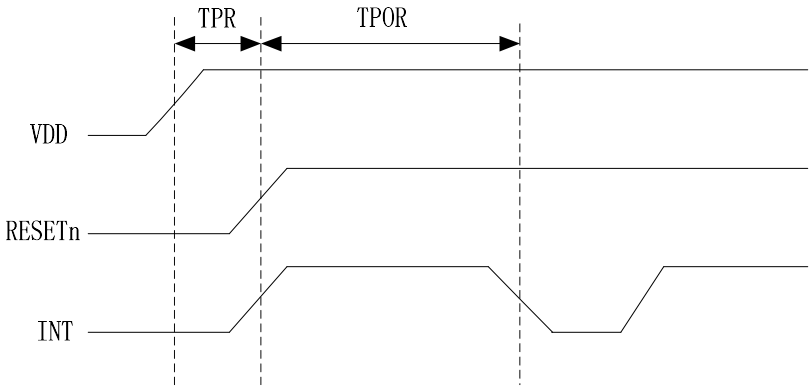
c. Host re-initiates START after writing data to CST340, then reads data from CST340; Sometimes host also re-initiates START after reading data form CST340, then write data to CST340, data format is shown as below:

S	Slave Address[7bit]	W[1bit]	ACK	DATA[8bit]	ACK	...	DATA[8bit]	ACK/ NACK	
RS	Slave Address[7bit]	R[1bit]	ACK	DATA[8bit]	ACK	...	DATA[8bit]	NACK	P

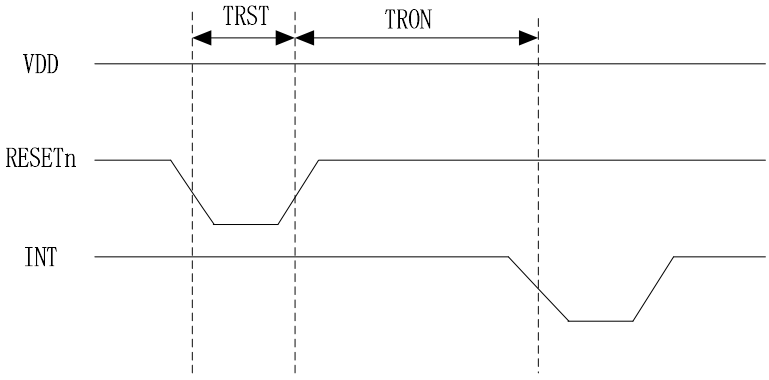
10.5 Power On/Reset

Built-in POR module keeps controller in RESET status until voltage is normal, controller will be reset when voltage is lower than threshold, all modules will be reset when the pin RSTn is low, this pin is connected with an internal RC filter, it can be floating, internal watch-dog will be triggered in abnormal status and touch controller will back to normal soon.

Power On Reset timing diagram:



Power on timing



External reset timing

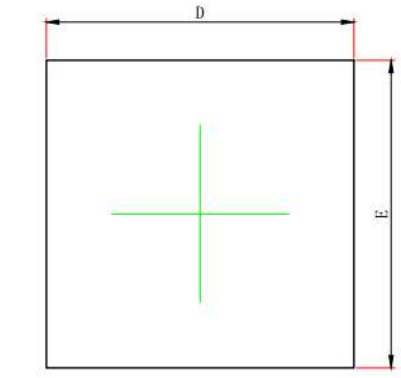
Symbol	Description	Typical	Unit
TPOR	Initialization time after power on	300	ms
TPR	Delay time before pull up RST pin	1	ms
TRON	Initialization time after reset	300	ms
TRST	Reset hold time (pulse width)	0.1	ms

10.6 Interrupt Mode

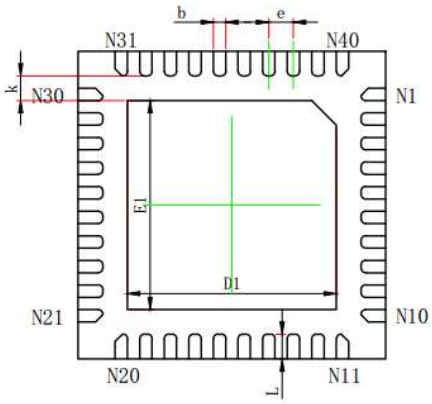
Touch controller uses IRQ to notify host reading data only valid touching happened, IRQ trigger mode can be configured as rising edge or falling edge to reduce power consumption and CPU burden; In standby mode IRQ can be used to wake up host when gesture happened.

11. Package information

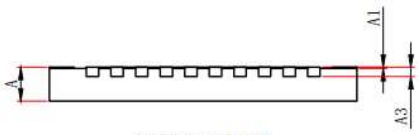
QFN40-5*5(P0.40 T0.55)



TOP VIEW



BOTTOM VIEW



SIDE VIEW

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.500	0.600	0.020	0.024
A1	0.000	0.050	0.000	0.002
A3	0.152REF.		0.006REF.	
D	4.924	5.076	0.194	0.200
E	4.924	5.076	0.194	0.200
D1	3.300	3.500	0.130	0.138
E1	3.300	3.500	0.130	0.138
b	0.150	0.250	0.006	0.010
e	0.400TYP.		0.016TYP.	
k	0.200MIN.		0.008MIN.	
L	0.350	0.450	0.014	0.018

12. Register Description

Version information register（ENUM_MODE_DEBUG_INFO mode）

Address	Description	BYTE3	BYTE2	BYTE1	BYTE0
0xD1F4	Key, TX and RX numbers	KEY_NUM	TP_NRX	NC	TP_NTX
0xD1F8	X/Y resolutions	TP_RESY		TP_RESX	
0xD1FC	Firmware checksum, boot loader window time	0xCACA		BOOT_TIMER	
0xD204	Chip type、Project ID	IC_TYPE		PROJECT_ID	
0xD208	Firmware version	FW_MAJOR	FW_MINOR	FW_BUILD	
0xD20C	Firmware checksum	checksum_H	checksum_H	checksum_L	checksum_L

Mode command register

Command	Description	Format
0xD101	ENUM_MODE_DEBUG_INFO; Entering reading information mode.	Write 0xD1 0x01
0xD102	System_Reset flag; Reset touch controller.	Write 0xD1 0x02
0xD104	Redo_Calibration flag, re-initialize algorithm.	Write 0xD1 0x04
0xD105	Deep sleep; Entering deep sleep mode.	Write 0xD1 0x05
0xD108	ENUM_MODE_DEBUG_POINTS; Entering debug reading points mode。	Write 0xD1 0x08
0xD109	ENUM_MODE_NORMAL;	Write 0xD1 0x09

	Entering normal reading points mode.	
0xD10A	ENUM_MODE_DEBUG_RAWDATA; Entering reading raw data mode	Write 0xD1 0x0A
0xD10B	ENUM_MODE_DEBUG_WRITE; Enter debug write mode	Write 0xD1 0x0B
0xD10C	ENUM_MODE_DEBUG_CALIBRATION; Enter redo debug mode	Write 0xD1 0x0C
0xD10D	ENUM_MODE_DEBUG_DIFF	Write 0xD1 0x0D
0xD119	ENUM_MODE_FACTORY	Write 0xD1 0x19

Touch information register (ENUM_MODE_NORMAL mode)

Address	High 4 bits of byte				Low 4 bits of byte			
	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0xD000	1st finger ID				1st finger status：Touch(0x06) or lift			
0xD001	High 8 bits of X resolution of 1st finger: X_Position>>4							
0xD002	High 8 bits of Y resolution of 1st finger: Y_Position>>4							
0xD003	Low 4 bits of X resolution of 1st finger				Low 4 bits of Y resolution of 1st finger			
0xD004	Pressure of 1st finger							
0xD005	Key report flag (0x80)				Finger number			
0xD006	Fixed 0xAB							
0xD007	2nd finger ID				2nd finger status: Touch(0x06) or lift			
0xD008	High 8 bits of X resolution of 2nd finger X_Position>>4							
0xD009	High 8 bits of Y resolution of 2nd Y_Position>>4							
0xD00A	Low 4 bits of X resolution of 2nd finger				Low 4 bits of Y resolution of 2nd finger			
0xD00B	Pressure of 2nd finger							
0xD00C	3rd finger ID				3rd finger status：Touch(0x06) or lift			
0xD00D	High 8 bits of X resolution of 3rd finger: X_Position>>4							
0xD00E	High 8 bits of Y resolution of 3rd finger: Y_Position>>4							
0xD00F	Low 4 bits of X resolution of 3rd finger				Low 4 bits of Y resolution of 3rd finger			
0xD010	Pressure of 3rd finger							
0xD011	4th finger ID				4th finger status：Touch(0x06) or lift			
0xD012	High 8 bits of X resolution of 4th finger: X_Position>>4							
0xD013	High 8 bits of Y resolution of 4th finger: Y_Position>>4							
0xD014	Low 4 bits of X resolution of 4th finger				Low 4 bits of Y resolution of 4th finger			

0xD015	Pressure of 4th finger	
0xD016	5th finger ID	5th finger status：Touch(0x06) or lift
0xD017	High 8 bits of X resolution of 5th finger:	X_Position>>4
0xD018	High 8 bits of Y resolution of 5th finger:	Y_Position>>4
0xD019	Low 4 bits of X resolution of 5th finger	Low 4 bits of Y resolution of 5th finger
0xD01A	Pressure of 5th finger	

Statement: Shanghai Hynitorn Microelectronics is not responsible for any external components and circuit, Shanghai Hynitorn Microelectronics also does not provide patent license of any external components and circuit. We reserve the right to modify the product information and specifications at any time without any notice.