

# GT928

## 10-point SOC Touch Solution for Tablet

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**Rev. 02——2012.12.26**

===== Announcement of exemption=====

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# 1. Overview

Based on Goodix 3<sup>rd</sup> generation Projected-Capacitive touch technology, GT928 has a sensing network with 32 driving channels and 24 sensing channels, built-in analog amplifier circuit, digital operation module and high-performance MPU, transfer the touch information through I<sup>2</sup>C.

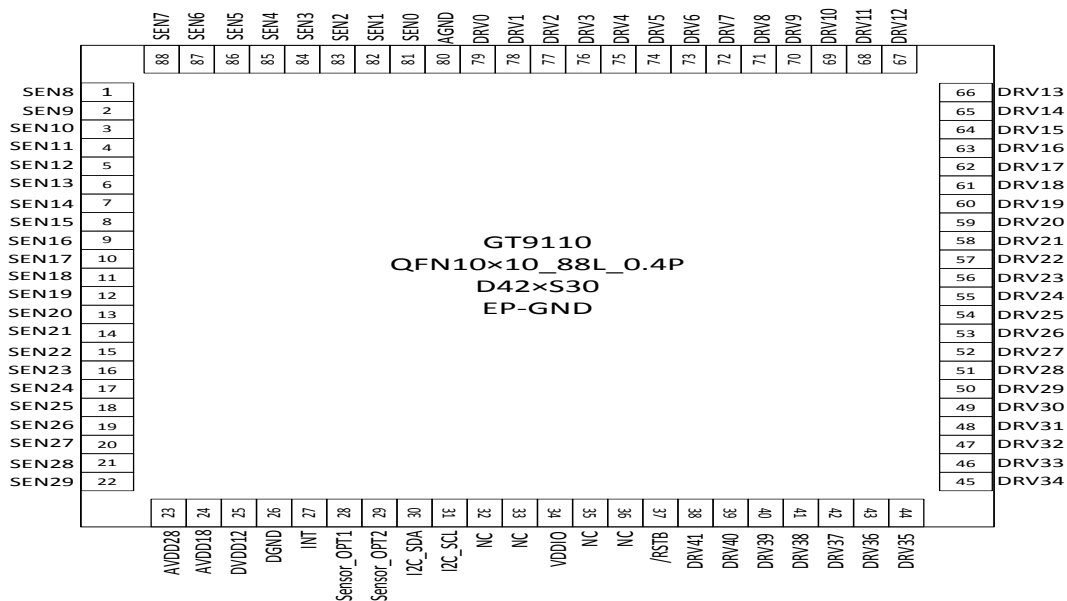
GT928 can support for 10 touch points in fast response time and low consumption, which is very suitable for Tablet and Netbook.

# 2. Features

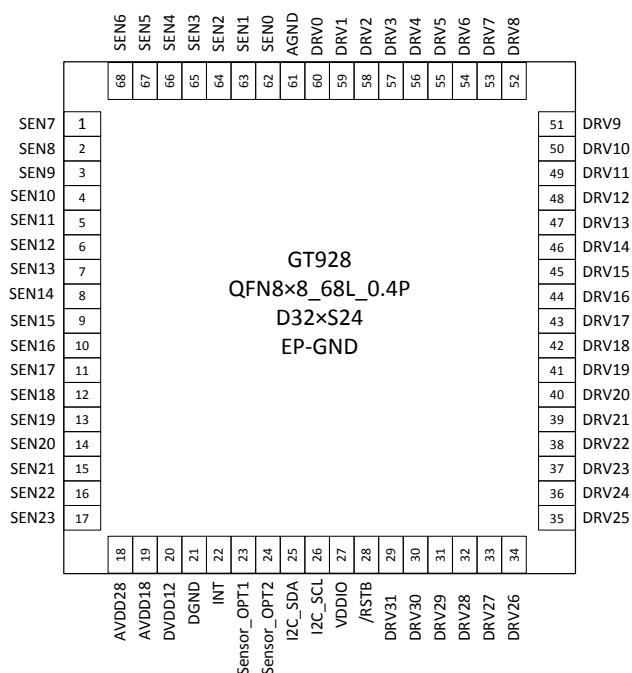
- ◇ Built-in circuit and high performance MPU
  - Touch scanning frequency: 100Hz
  - 10 point touch, touch point output in coordinates type
  - Unified firmware version for different Touch-panel size
  - Single power supply, Built in 1.8V LDO
  - Flash craft, support online burning
- ◇ Capacitive touch screen sensor
  - Channel:32 (driving)\*24 (sensing)
  - Support screen size: 7"~10.1"
  - Supporting four touch keys
  - Support both ITO glass and ITO Film
  - Supported Cover Lens Thickness:  
0.7mm ≦ Glass ≦ 2mm; 0.5mm ≦ PMMA ≦ 1.2mm
  - Built-in frequency hopping, support OGS full lamination
- ◇ Environmental applicable performance
  - Initialized automatic calibration
  - Automatic temperature drift compensation
  - Operating temperature: -40℃~+85℃, humidity: ≦95%RH
  - Storage temperature: -60℃~+125℃, humidity: ≦95%RH
- ◇ Communication interface
  - Standard I<sup>2</sup>C communication protocol
  - Working in I<sup>2</sup>C Slave mode
  - Support 1.8V~3.3V interface level

- ✧ Wake-up time
  - From Green mode: <48ms
  - From Sleep mode: <200ms
  - Initialization: <200ms
- ✧ Power supply:
  - Single power: 2.8V~3.3V
- ✧ Power ripple:
  - $V_{pp} \leq 50\text{mV}$
- ✧ Packaging:
  - GT928: 68 pins, 8mm\*8mm QFN\_0.4P
- ✧ Development supporting tools
  - Touch-panel module's performance analysis tool
  - parameter detector & configuration capture of touch panel
  - Q/C tools for mass production
  - Developing guide & reference code supporting
  -

### 3. Chip Diagram



## 4. Pin Definition



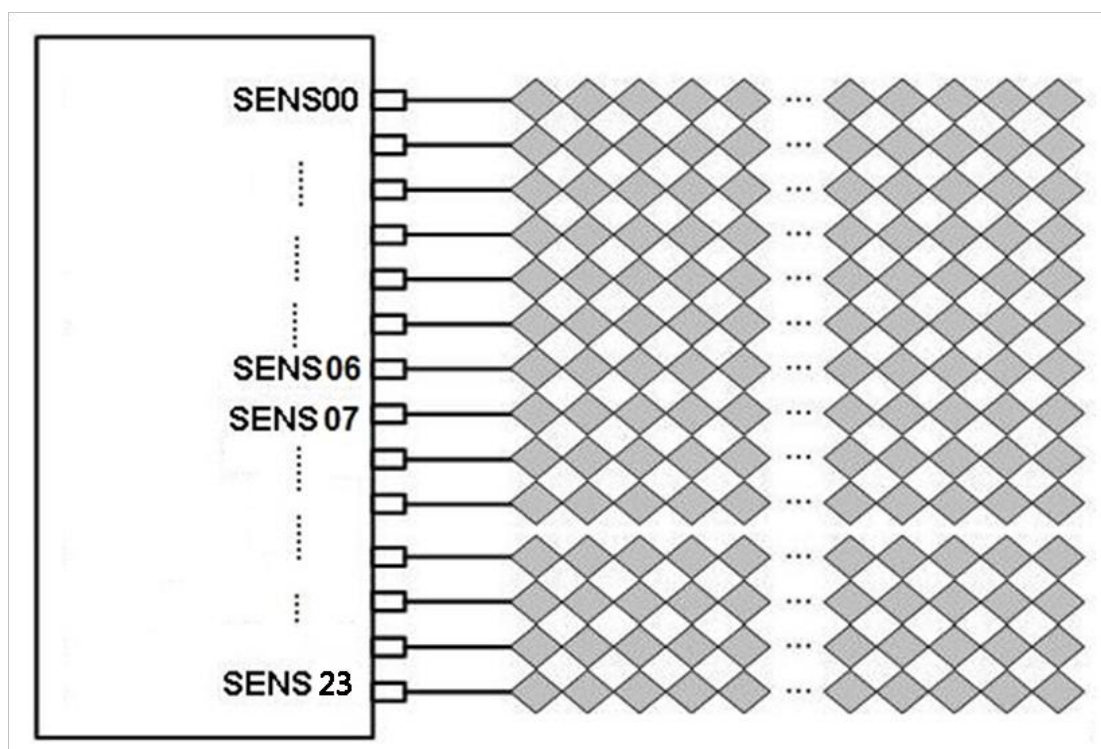
Pin No.	Name	Description	Remark
1~17	SENS7~SENS23	Sensing channels	
18	AVDD28	Analog VDD 2.8V	2.2uF to GND
19	AVDD18	Analog VDD 1.8V	2.2uF to GND
20	DVDD12	Digital VDD 1.2V	2.2uF to GND
21	DGND	Digital ground	
22	INT	Interrupt	
23	Sensor_OPT1	Sensor option pin1	
24	Sensor_OPT2	Sensor option pin2	External pull-down res.
25	I2C_SDA	I <sup>2</sup> C_data	External pull-up res.
26	I2C_SCL	I <sup>2</sup> C_clock	External pull-up res.
27	VDDIO	VDD of GPIO	2.2uF to GND 1、floating:1.8V 2、 to AVDD:AVDD
28	/RSTB	Reset	external pull-up low valid
29~60	DRV31~DRV0	Driving channels	
61	AGND	Analog ground	
62~68	SENS0~SENS6	Sensing channels	

## 5. Sensor Development

### 5.1. Arrangement of Sensing Channels

GT928 has 24 sensing pins: SENS0~SENS23, which are directly connected with ITO sensors. Please use “Channel Selector” to select channel & arrange the channel sequence when ITO channel is less than detection channel of the chip.

Example: Layout all the ITO races on the same side, connected in the sequence from 0 to 23 or 23 to 0:



### 5.2. Arrangement of Driving Channels

GT928 has 32 driving channels in total, which are directly connected with 32 ITO sensors. When drivers are less than driving channels, please refer to “Channel Selector” to select Channel. 32 driving channels can be arranged freely w/o any sequence. After the layout of driving channels, relevant registers of GT928 shall be configured to ensure logic position relations consistent with physical position relations of driving channels.

### 5.3. Design Specification of ITO Sensor

DITO

	<b>GT928</b>
<b>Impedance of driving channel race</b>	$\cong 3K\Omega$
<b>Impedance of driving channel</b>	$\cong 10K\Omega$
<b>Impedance of sensing channel race</b>	$\cong 10K\Omega$
<b>Impedance of sensing channel</b>	$\cong 40K\Omega$
<b>Capacitor of node</b>	$\cong 4pF$
<b>Constant of sensing channel RC</b>	$\cong 6us. Typ.=3.6us$

## SITO

	<b>GT928</b>
<b>Impedance of driving channel race</b>	$\cong 3K\Omega$
<b>Impedance of driving channel</b>	$\cong 10K\Omega$
<b>Impedance of sensing channel race</b>	$\cong 10K\Omega$
<b>Impedance of sensing channel</b>	$\cong 10K\Omega$
<b>Capacitor of node</b>	$\cong 4pF$
<b>Constant of sensing channel RC</b>	$\cong 6us. Typ.=3.6us$

In the course of actual TP module production, driving channels and sensing channels are made with ITO or other invisible conductive material, and the volatility of impedance is relatively small. When the channel races are used with metallic material, some races may be oxidized and their impedance will become larger due to process control or other reasons, the impedance will be different; when the wires are used with ITO materials, though the races in all channels will be maintained consistent by virtue of matching length and width in design, there still be some difference. In order to guarantee data consistency and evenness in the whole panel, the wiring impedance shall meet the requirements as above table.

## 5.4. Touch Keys

GT928 can support 4 separated touch keys. There are two ways to design these touch keys:

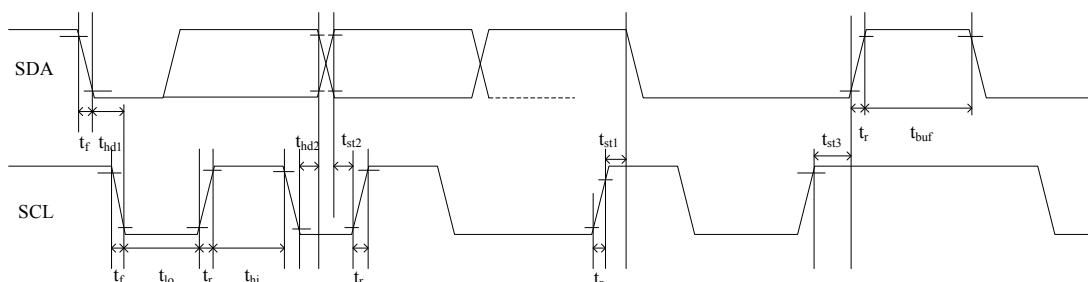
Carried out by ITO sensor: Touch keys are carried out by one driving channel with different sensing channels. The driving channel is used only for touch keys, but the sensing channels should be reused by the visual area of the touch panel, the key position will be determined with configuration information.

Carried out by FPC: When using FPC to design touch keys, please comply with the principle above-mentioned.

## 6. I<sup>2</sup>C Communication

### 6.1. I<sup>2</sup>C Communication

GT928 provides standard I<sup>2</sup>C interface for communication. In the system, GT928 always works in slave mode, all communications are initiated by master, and the baud rate can be up to 400K bps. The definition of I<sup>2</sup>C timing is as following:



Test condition1: 1.8V communication interface, 400Kbps, pull up resistor is 2K ohm

Parameter	Symbol	Min.	Max.	Unit
SCL low period	T <sub>lo</sub>	0.9	-	us
SCL high period	T <sub>hi</sub>	0.8	-	us
SCL setup time for START condition	t <sub>st1</sub>	0.4	-	us
SCL setup time for STOP condition	t <sub>st3</sub>	0.4	-	us
SCL hold time for START condition	t <sub>hd1</sub>	0.3	-	us
SDA setup time	t <sub>st2</sub>	0.4	-	us
SDA hold time	t <sub>hd2</sub>	0.4	-	us

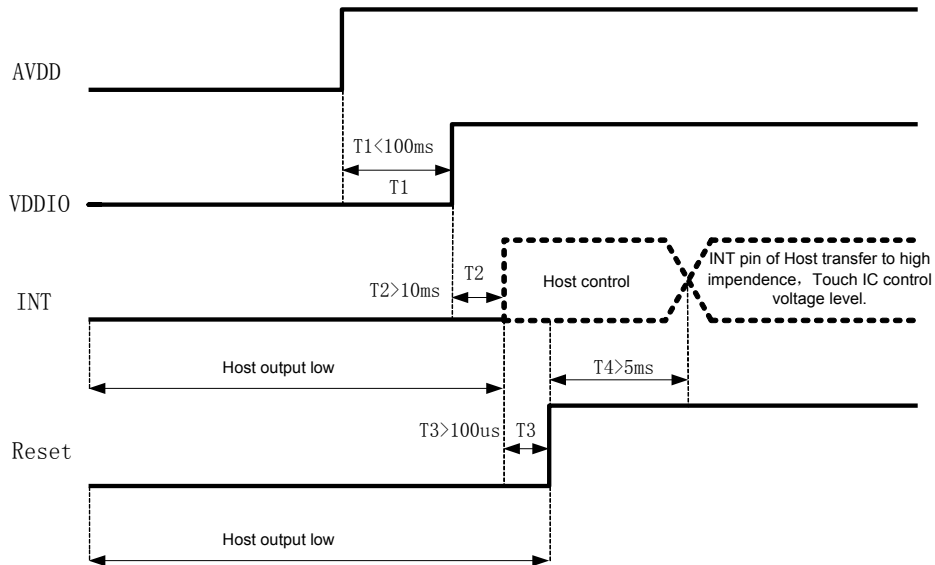
Test condition2: 3.3V communication interface, 400Kbps, pull up resistor is 2K ohm

Parameter	Symbol	Min.	Max.	Unit
SCL low period	T <sub>lo</sub>	0.9	-	us
SCL high period	T <sub>hi</sub>	0.8	-	us
SCL setup time for START condition	t <sub>st1</sub>	0.4	-	us
SCL setup time for STOP condition	t <sub>st3</sub>	0.4	-	us
SCL hold time for START condition	t <sub>hd1</sub>	0.3	-	us
SDA setup time	t <sub>st2</sub>	0.4	-	us
SDA hold time	t <sub>hd2</sub>	0.4	-	us

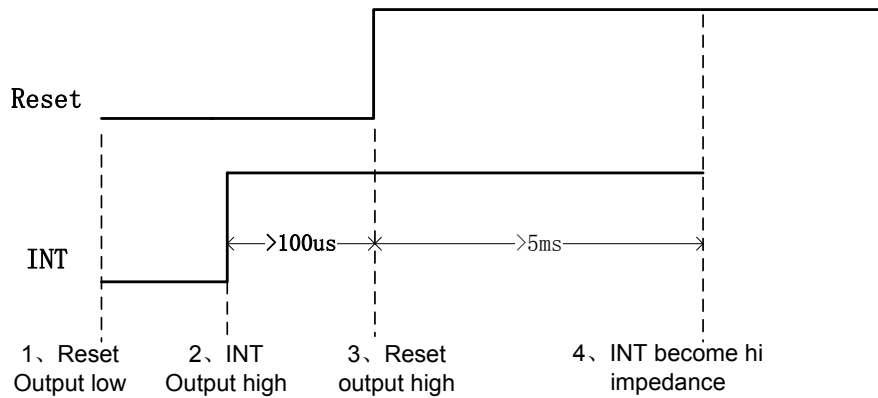
GT928 has 2 sets of slave address 0xBA/0xBB & 0x28/29. Master can control Reset & INT pin to configure the slave address in power on initial state like following:

**Power on diagram:**

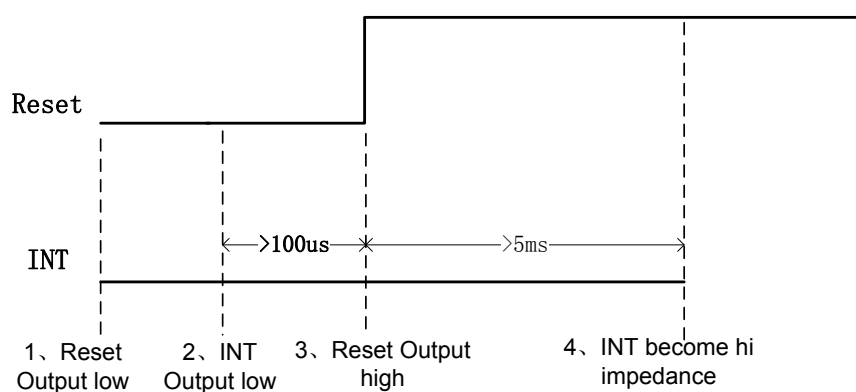




**Timing of setting slave address to 0x28/0x29:**



**Timing of setting slave address to 0xBA/0xBB:**



**a) Data Transmission**

(eg. slave address is 0xBA/0xBB)

Communication is always initiated by master, A high-to-low transition of SDA with SCL high is a start condition.

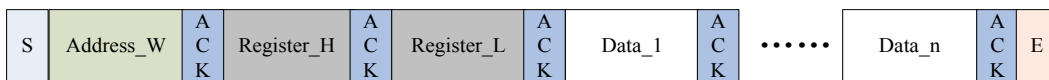
All addressing signal are serially transmitted to and from on bus in 8-bit word. GT928 sends a “0” to acknowledge when the addressing word is 0xBA/BB( or 0x28/0x29 ). This happens during the ninth clock cycle. If the slave address is not matched, GT928 will stay in idle state.

The data words are serially transmitted to and from in 9-bit information: 8-bit data + 1-bit ACK or NACK sent by GT928. Data changes during SCL low periods and keep valid during SCL high.

A low-to-high transition of SDA with SCL high is a stop condition.

**b) Write Data to GT928**

(eg. slave address is 0xBA/0xBB)



**Write operations**

Please check the above figure, master start the communication first, and then sends device address 0xBA preparing for a write operation.

After receiving ACK from GT928, master sends out 16-bit register address, and then the data word in 8-bit, which is going to be wrote into GT928.

The address pointer of GT928 will automatically increase one after one byte writing, so master can sequentially write in one operation. When operation finished, master stop the communication.

**c) Read Data from GT928**

(eg. slave address is 0xBA/0xBB)



**Read operation**

Please check the above figure, master start the communication first, and then sends device address 0xBA for a write operation.

After receiving ACK from GT928, master sends out 16-bit register address, to set the address pointer of GT913. After receiving ACK, master produce start signal once again and send device address 0xBB, then read data word from GT928 in 8-bit.

GT928 also supports sequential read operation, and the default setting is sequential

read mode. Master shall send out ACK after every byte reading successfully but NACK after the last one. Then sends stop signal to finish the communication.

## 6.2. Register Information of GT928

### a) Real Time Order

(Write Only)

Addr	Name	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0x8040	Command	0: read coordinate 1: read diff data or raw data 2: software reset3:baseline update 4: baseline calibration 5: screen off 3&4 are still internal test							
0x8041	Reserved	Reserved							
0x8042	Proximity_En	Switch of Proximity							

### b) Configuration Information

(R/W)

寄存器	Config Data	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0x8047	Config_Version	Version of the configuration							
0x8048	X Output Max (Low Byte)	resolution of X axis							
0x8049	X Output Max (High Byte)								
0x804A	Y Output Max (Low Byte)	resolution of Y axis							
0x804B	Y Output Max (High Byte)								
0x804C	Touch Number	Reserved				Touch No.: 1~10			
0x804D	Module_Switch1	Reserved		Stretch_rank		X2Y	Sito	INT trigger method 00 : rising edge trigger 01 : falling edge trigger 02 : low level enquiry 03 : high level enquiry	
0x804E	Module_switch2	Reserved							Touch_key
0x804F	Shake_Count	Reserved				Finger shake count			
0x8050	Filter	First_Filter		Normal_Filter (filtering value of original coordinate window, coefficiency is 1)					
0x8051	Large_Touch	Number of touch in large area							
0x8052	Noise_Reduction	Reserved				Value of noise elimination (coefficient is 1)			

0x8053	Screen_Touch_Level	Threshold of touch grow out of nothing			
0x8054	Screen_Leave_Level	Threshold of touch grow out of nothing			
0x8055	Low_Power_Control	Reserved		Time to low power consumption (0~15s)	
0x8056	Refresh_Rate	Reserved		Coordinate report rate (Cycle: 5+N ms)	
0x8057	x_threshold	Reserved			
0x8058	y_threshold				
0x8059	X_Speed_Limit	Reserved			
0x805A	Y_Speed_Limit				
0x805B	Space	Blank area of boarder-top (coefficient 32)		Blank area of Boarder-bottom (coefficient 32)	
0x805C		Blank area of boarder-left (coefficient 32)		Blank area of Boarder-right (coefficient 32)	
0x805D	Stretch_Rate	Reserved		Level of weak stretch (Strtch X/16 Pitch) (release version is invalid)	
0x805E	Stretch_R0	Interval 1 coefficient			
0x805F	Stretch_R1	Interval 2 coefficient			
0x8060	Stretch_R2	Interval 3 coefficient			
0x8061	Stretch_RM	All intervals base number			
0x8062	Drv_GroupA_Num	All_Driving	Reserved	Driver_Group_A_number	
0x8063	Drv_GroupB_Num	Reserved		Dual_Freq	Driver_Group_B_number
0x8064	Sensor_Num	Sensor_Group_B_Number			Sensor_Group_A_Number
0x8065	FreqA_factor	Driver frequency double frequency coefficient of Driver group A GroupA_Frequency = Multiplier factor * baseband			
0x8066	FreqB_factor	Driver frequency double frequency coefficient of Driver group B GroupB_Frequency = Multiplier factor * baseband			
0x8067	Pannel_BitFreqL	Baseband of Driver group A/B (1526HZ<baseband<14600Hz)			
0x8068	Pannel_BitFreqH				
0x8069	Pannel_Sensor_TimeL	Time interval of the neighbouring two driving signal (Unit: us), Reserved (Released version invalid)			
0x806A	Pannel_Sensor_TimeH				
0x806B	Pannel_Tx_Gain	Reserved		Pannel_Drv_output_R 4 gears	Pannel_DAC_Gain 0:Gain maximum 7: Gain minimum
0x806C	Pannel_Rx_Gain	Pannel_PGA_C	Pannel_PGA_R	Pannel_Rx_Vcmi 4 gears	Pannel_PGA_Gain 8 gears
0x806D	Pannel_Dump_Shift	Reserved			Magnification coefficient of original value (The Nth power of 2)

0x806E	Drv_Frame_Control	Reserved	SubFrame_DrvNum		Repeat_Num
0x806F	NC	Reserved			
0x8070	NC	Reserved			
0x8071	NC	Reserved			
0x8072	Stylus_Tx_Gain	Undefined (invalid when stylus_priority=0)			
0x8073	Stylus_Rx_Gain	Undefined (invalid when stylus_priority=0)			
0x8074	Stylus_Dump_Shift	Magnification coefficient of original value (The Nth power of 2), Reserved			
0x8075	Stylus_Driver_Touch_Level	Stylus effective threshold (driving), Reserved			
0x8076	Stylus_Sensor_Touch_Level	Stylus effective threshold (sensing), Reserved			
0x8077	Stylus_Control	Pen mode escape time out period (Unit: Sec)			
0x8078	Base_reduce	S-Style improve quantity (usually 2-4)	Reserved		
0x8079	NC	Reserved			
0x807A	Freq_Hopping_Start	Frequency hopping start frequency (Unit: 2KHz, 50 means 100KHz )			
0x807B	Freq_Hopping_End	Frequency hopping stop frequency (Unit: 2KHz, 150 means 300KHz )			
0x807C	Noise_Detect_Times	Detect_Stay_Times	Detect_Confirm_Times		
0x807D	Hopping_Flag	Hopping_En	Reserved		Detect_Time_Out
0x807E	Hopping_Threshold	Large_Noise_Threshold		Hopping_Hit_Threshold	
0x807F	Noise_Threshold	Threshold of noise level			
0x8080	NC	Reserved			
0x8081	NC	Reserved			
0x8082	Hopping_seg1_BitFreqL	Frequency hopping segment band 1 central frequency (for driver A/B)			
0x8083	Hopping_seg1_BitFreqH				
0x8084	Hopping_seg1_Factor	Frequency hopping segment 1 central frequency coefficient			
0x8085	Hopping_seg2_BitFreqL	Frequency hopping segment band 2 central frequency (for driver A/B)			
0x8086	Hopping_seg2_BitFreqH				
0x8087	Hopping_seg2_	Frequency hopping segment 2 central frequency coefficient			

	Factor		
0x8088	Hopping_seg3_BitFreqL	Frequency hopping segment band 3 central frequency (for driver A/B)	
0x8089	Hopping_seg3_BitFreqH		
0x808A	Hopping_seg3_Factor	Frequency hopping segment 3 central frequency coefficient	
0x808B	Hopping_seg4_BitFreqL	Frequency hopping segment band 4 central frequency (for driver A/B)	
0x808C	Hopping_seg4_BitFreqH		
0x808D	Hopping_seg4_Factor	Frequency hopping segment 4 central frequency coefficient	
0x808E	Hopping_seg5_BitFreqL	Frequency hopping segment band 5 central frequency (for driver A/B)	
0x808F	Hopping_seg5_BitFreqH		
0x8090	Hopping_seg5_Factor	Frequency hopping segment 5 central frequency coefficient	
0x8091	NC	Reserved	
0x8092	NC	Reserved	
0x8093	Key 1	Key 1 Position: 0-255 valid (0 means no touch, it means independent touch key when 4 of the keys are 8 multiples)	
0x8094	Key 2	Key 2 position	
0x8095	Key 3	Key 3 position	
0x8096	Key 4	Key 4 position	
0x8097	Key_Area	Time limit for long press(1~16 s)	Touch valid interval setting: 0-15 valid
0x8098	Key_Touch_Level	Key threshold of touch key	
0x8099	Key_Leave_Level	Key threshold of touch key	
0x809A	Key_Sens	KeySens_1(sensitivity coefficient of key 1, same below)	KeySens_2
0x809B	Key_Sens	KeySens_3	KeySens_4
0x809C	Key_Restrain	Finger from screen left after inhibition of key time(Unit:100ms,0 means 600ms)	The independent button pro key inhibition parameters
0x809D	NC	Reserved	
0x809E	NC	Reserved	
0x809F	NC	Reserved	
0x80A0	NC	Reserved	
0x80A1	NC	Reserved	
0x80A2	Proximity_Drv_Select	Drv_Start_Ch (start channel of driving direction)	Drv_End_Ch (End channel)
0x80A3	Proximity_Sens_Select	Sens_Start_Ch (start channel of sensing direction)	Sens_End_Ch (End channel)
0x80A4	Proximity_Touch_Level	set value×10= Proximity effective threshold value	
0x80A5	Proximity_	set value ×10= Proximity ineffective threshold value	

	Leave_Level	
0x80A6	Proximity_Sample_Add_Times	Sample value accumulated times
0x80A7	Proximity_Sample_Dec_ValL	Samle value minus this value (16 bit ) then accumulate, low byte
0x80A8	Proximity_Sample_Dec_ValH	Samle value minus this value (16 bit ) then accumulate, high byte
0x80A9	Proximity_Leave_Shake_Count	Leave Proximity shake count
0x80AA	Self_Cap_Tx_gain	Self-capacitance send gains
0x80AB	Self_Cap_Rx_gain	Self-capacitance receive gains
0x80AC	Self_Cap_Dump_Shift	Self capacitance original value magnificent coefficient ( the Nth power of 2 )
0x80AD	SCap_Diff_Up_Level_Drv	自电容抑制悬浮上升阈值(驱动方向)
0x80AE	Scap_Merge_Touch_Level_Drv	Self-capacitance Touch Level (driving direction)
0x80AF	SCap_Pulse_TimeL	Self-capacitance take sample time (low byte)
0x80B0	SCap_Pulse_TimeH	Self-capacitance take sample time (high byte)
0x80B1	SCap_Diff_Up_Level_Sen	Self capacitance suppress floating rising threshold (sensing direction)
0x80B2	Scap_Merge_Touch_Level_Sen	Self-capacitance Touch Level (sensing direction)
0x80B3	NC	Reserved
0x80B4	NC	Reserved
0x80B5	NC	Reserved
0x80B6	NC	Reserved
0x80B7~ 0x80CE	Sensor_CH0~ Sensor_CH23	ITO Sensor corresponding chip channel number
0x80CF~ 0x80D4	NC	Reserved
0x80D5~ 0x80F4	Driver_CH0~ Driver_CH31	ITO Driver corresponding chip channel number
0x80F5~ 0x80FE	NC	Reserved
0x80FF	Config_Chksum	configuration information verify (the complement number of total byte from 0x8047 to 0x80FE)
0x8100	Config_Fresh	signal of updated configuration (the host writes)

**c) Coordinates Information**

Addr	Access	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
0x8140	R	Product ID ( first Byte, ASCII)							
0x8141	R	Product ID ( second Byte, ASCII)							
0x8142	R	Product ID ( third Byte, ASCII)							
0x8143	R	Product ID ( forth Byte, ASCII)							

0x8144	R	Firmware version ( HEX.low byte )				
0x8145	R	Firmware version ( HEX.high byte )				
0x8146	R	x coordinate resolution ( low byte )				
0x8147	R	x coordinate resolution ( high byte )				
0x8148	R	y coordinate resolution ( low byte )				
0x8149	R	y coordinate resolution ( high byte )				
0x814A	R	Vendor_id ( 当前模组选项信息 )				
0x814B	R	Reserved				
0x814C	R	Reserved				
0x814D	R	Reserved				
0x814E	R/W	buffer status	large detect	Reserved	HaveKey	number of touch points
0x814F	R	track id				
0x8150	R	point 1 x coordinate (low byte)				
0x8151	R	point 1 x coordinate (high byte)				
0x8152	R	point 1 y coordinate (low byte)				
0x8153	R	point 1 y coordinate (high byte)				
0x8154	R	Point 1 size (low byte)				
0x8155	R	point 1 size (high byte)				
0x8156	R	Reserved				
0x8157	R	track id				
0x8158	R	point 2 x coordinate (low byte)				
0x8159	R	point 2 x coordinate (high byte)				
0x815A	R	point 2 y coordinate (low byte)				
0x815B	R	point 2 y coordinate (high byte)				
0x815C	R	point 2 size (low byte)				
0x815D	R	point 2 size (high byte)				
0x815E	R	Reserved				
0x815F	R	track id				
0x8160	R	point 3 x coordinate (low byte)				
0x8161	R	point 3 x coordinate (high byte)				
0x8162	R	point 3 y coordinate (low byte)				
0x8163	R	point 3 y coordinate (high byte)				
0x8164	R	point 3 size (low byte)				
0x8165	R	point 3 size (high byte)				
0x8166	R	Reserved				
0x8167	R	track id				
0x8168	R	point 4 x coordinate (low byte)				
0x8169	R	point 4 x coordinate (high byte)				
0x816A	R	point 4 y coordinate (low byte)				
0x816B	R	point 4 y coordinate (high byte)				
0x816C	R	point 4 size (low byte)				

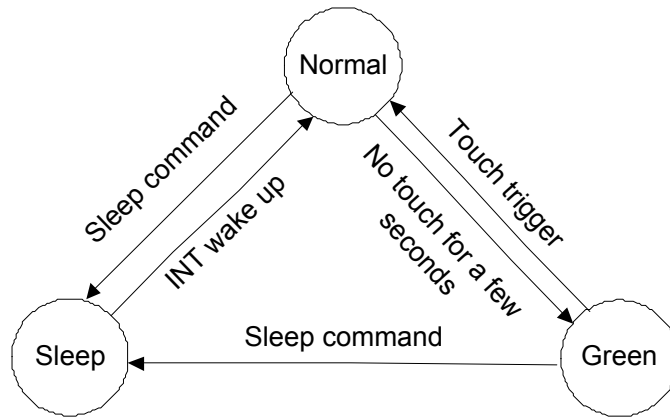


0x816D	R	point 4 size (high byte)
0x816E	R	Reserved
0x816F	R	track id
0x8170	R	point 5 x coordinate (low byte)
0x8171	R	point 5 x coordinate (high byte)
0x8172	R	point 5 y coordinate (low byte)
0x8173	R	point 5 y coordinate (high byte)
0x8174	R	point 5 size (low byte)
0x8175	R	point 5 size (high byte)
0x8176	R	Reserved
0x8177	R	track id
0x8178	R	point 6 x coordinate (low byte)
0x8179	R	point 6 x coordinate (high byte)
0x817A	R	point 6 y coordinate (low byte)
0x817B	R	point 6 y coordinate (high byte)
0x817C	R	point 6 size (low byte)
0x817D	R	point 6 size (high byte)
0x817E	R	Reserved
0x817F	R	track id
0x8180	R	point 7 x coordinate (low byte)
0x8181	R	point 7 x coordinate (high byte)
0x8182	R	point 7 y coordinate (low byte)
0x8183	R	point 7 y coordinate (high byte)
0x8184	R	point 7 size (low byte)
0x8185	R	point 7 size (high byte)
0x8186	R	Reserved
0x8187	R	track id
0x8188	R	point 8 x coordinate (low byte)
0x8189	R	point 8 x coordinate (high byte)
0x818A	R	point 8 y coordinate (low byte)
0x818B	R	point 8 y coordinate (high byte)
0x818C	R	point 8 size (low byte)
0x818D	R	point 8 size (high byte)
0x818E	R	Reserved
0x818F	R	track id
0x8190	R	point 9 x coordinate (low byte)
0x8191	R	point 9 x coordinate (high byte)
0x8192	R	point 9 y coordinate (low byte)
0x8193	R	point 9 y coordinate (high byte)
0x8194	R	point 9 size (low byte)
0x8195	R	point 9 size (high byte)

0x8196	R	Reserved
0x8197	R	track id
0x8198	R	point 10 x coordinate (low byte)
0x8199	R	point 10 x coordinate (high byte)
0x819A	R	point 10 y coordinate (low byte)
0x819B	R	point 10 y coordinate (high byte)
0x819C	R	point 10 size (low byte)
0x819D	R	point 10 size (high byte)
0x819E	R	Reserved
0x819F	R	KeyValue

# 7. Function Description

## 7.1. Working Mode



### a) Normal Mode

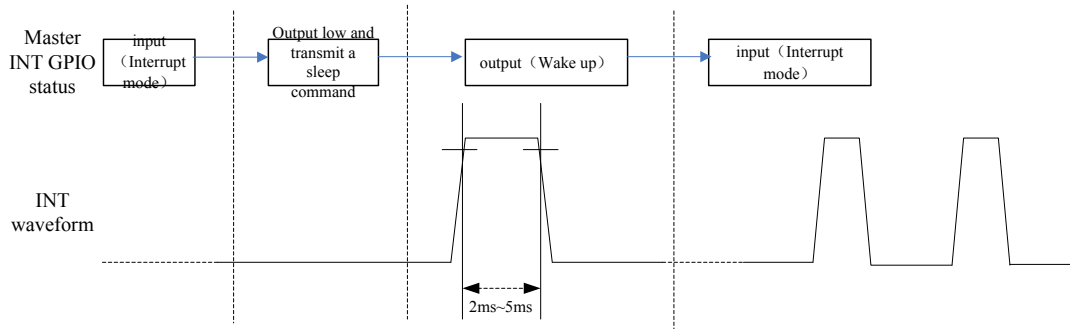
When GT928 is in Normal mode, touch scanning period is about 7ms ~ 10ms depending on the setting. The chip will automatically enter into Green mode if no touch for short time within 0~15s depending on setting and the step is 1s.

### b) Green Mode

In Green mode, the touch scanning cycle is fixed as 40ms. It will automatically enter into Normal mode if any touch is detected.

### c) Sleep Mode

For a lower consumption, Master can ask GT928 to enter Sleep mode through I<sup>2</sup>C command (before the command, please drive low to INT pin). Drive high to the INT pin of GT928 2~5ms will make GT928 return back to normal mode.



## **7.2. Pulse Calling**

GT928 will inform master to read coordinate information only when touch event happen. Pin “INT” will outputs a high-to-low (or low-to-high, low level, high level etc, set by configuration information) signal to inform master.

## **7.3. Automatic Calibration**

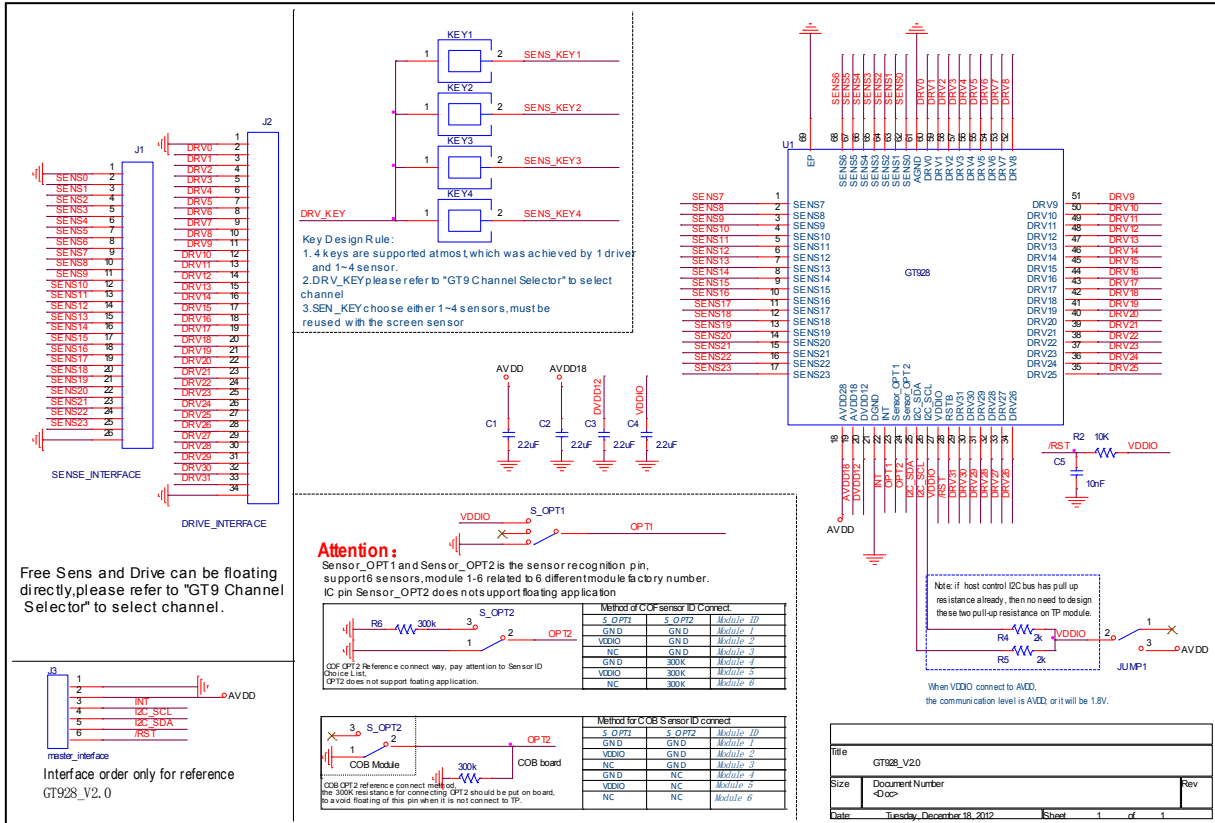
### **a) Initialization Calibration**

Different temperature, humidity and physical structure will affect the sensor’s baseline. According to environmental situation GT928 will update the baseline automatically in initialized 200ms.

### **b) Automatic Temperature Drift**

Slow change of temperature, humidity or dust and other environmental factors will also affect the sensor’s baseline. GT928 calculates and analyzes historical data, and compare to the current data variation. Base on this, the baseline will be calibration automatically.

# 8. Reference Circuit Diagram



Reference Circuit Diagram of GT928

**Notes:**

1. This circuit only shows basic applications, and may be modified according to actual conditions.
2. The capacitor should be used material of X7R.

## 9. Electrical Characteristics

### 9.1. Absolute Operation Rating

(Temperature 25°C)

Parameter	Min.	Max.	Unit
Analog power AVDD28 (refer to AGND)	2.66	3.47	V
VDDIO (refer to DGND)	1.7	3.47	V
Digital I/O	0	3.47	V
Analog I/O	0	3.47	V
Operating temperature	-40	85	°C
Storage temperature	-60	125	°C
Welding temperature (10s)		300	°C
ESD protective voltage (HB Model)		±2	KV

### 9.2. Operating Characteristic

Parameter	Min.	Typical	Max.	Unit
AVDD28	2.8	-	3.3	V
VDDIO	1.8	-	3.3	V
Operating temperature	-20	25	85	°C

### 9.3. AC Characteristic

(Temperature 25°C, AVDD=2.8V)

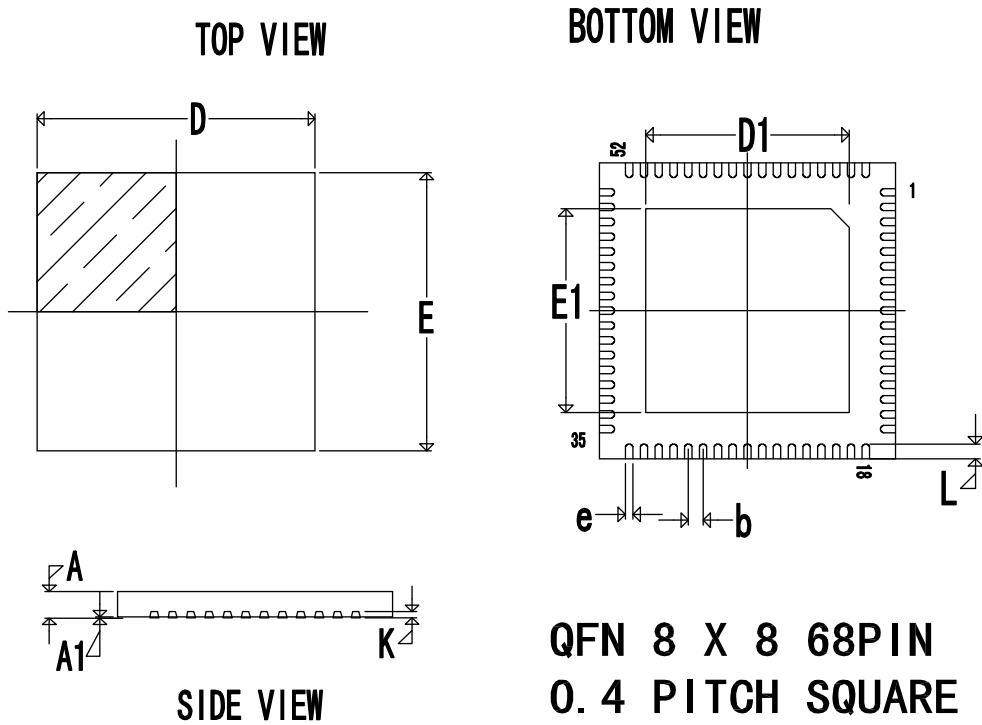
Parameter	Min.	Typical	Max.	Unit
OSC oscillation frequency	59	60	61	MHz
I/O output rise time	—	-	0.5	ns
I/O output fall time	—	-	0.5	ns

### 9.4. DC Characteristic

(Temperature 25°C, VDD=2.8V)

Parameter	Min.	Typical	Max.	Unit
Operating current (Normal mode)	-	13		mA
Operating current (Green mode)	-	4.6	-	mA
Operating current (Sleep mode)	70		120	uA
Input voltage in low level(VDDIO=1.8V)	-0.3	0	0.45	V
Input voltage in high level(VDDIO=1.8V)	1.35	1.8	2.1	V

# 10. Package



Symbol	Dimensions In Millimeters		
	Min.	Normal	Max.
A	0.70	0.75	0.80
A1	0.00	0.035	0.05
b	0.40BSC		
D	8.00BSC		
D1	5.40	5.50	5.60
E	8.00BSC		
E1	5.40	5.50	5.60
e	0.15	0.20	0.25
L	0.30	0.40	0.50
K	0.203BSC		

## 11. Document History Record

Version	Date	Description of change
Rev. 00	2012-11-05	Draft version
Rev.01	2012-11-07	Update following information: 1. Register information 2. Reference Circuit Diagram 3. Package
Rev.02	2012-12-26	Modified operating temperature, storage temperature, Updated package information



## 12. Contact Information



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