GA6572

10-Point Capacitive Touch Controller for Automotive Electronics

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Contents

1. Overview

GA6572 is the capacitive touch solution designed for automotive electronics. It contains up to 42 transmitters (Tx) and 30 receivers (Rx) to provide superior touch accuracy If the sensor pitch is within 5.5 mm, the supported touch screen for automotive market is 10.1” or 10.25”; if the sensor pitch ranges from 5.5 mm to 6.5 mm , the supported touch screen size can reach up to 12.3”(aspect ratio: 8:3).

GA6572 supports up to 10 concurrent touches with real-time tracking of accurate position and motion trajectory as well as touch area. In addition,it features high noise immunity, moisture immunity and support for gloved-hand input.

2. Features

- Compliant with “AEC-Q 100 Grade 2”
- Compliant with IATF 16949
- Leather glove thickness supported: up to 1.5 mm
- Moisture immunity: wet-finger operation and moisture touch
- Supports 10 touch keys
- Configurable refresh rate
- Supports PowerKey function
- Supports Rx2Tx function
- Supports COB and COF
- Built-in capacitive sensing circuit and high-performance MPU
  - Report rate: up to 150 Hz
  - Outputs touch coordinates in real time
  - Unified software applicable to capacitive touch screens of various sizes
  - Single power supply, internal 1.8V LDO
- Capacitive touch sensor
  - Channels: 42 (Tx channels)*30(Rx channels)
  - Supports touch key design on FPC
  - Supports ITO glass and ITO Film

- Cover Lens thickness supported: 0.55 mm ≤ Glass ≤ 2 mm,
  0.5 mm ≤ Plastic ≤ 1.2 mm
- GG\GFF\OGS\PG full lamination

✧ Environmental adaptability

- Self-calibration during initialization
- Automatic drift compensation
- Operating temperature: -40℃ to +105℃

✧ Host interface

- Standard I^2C interface, I^2C address: 0x5D
- Works as slave device
- Supports 1.8V to 3.3V host interface voltage

✧ Power supply voltage:

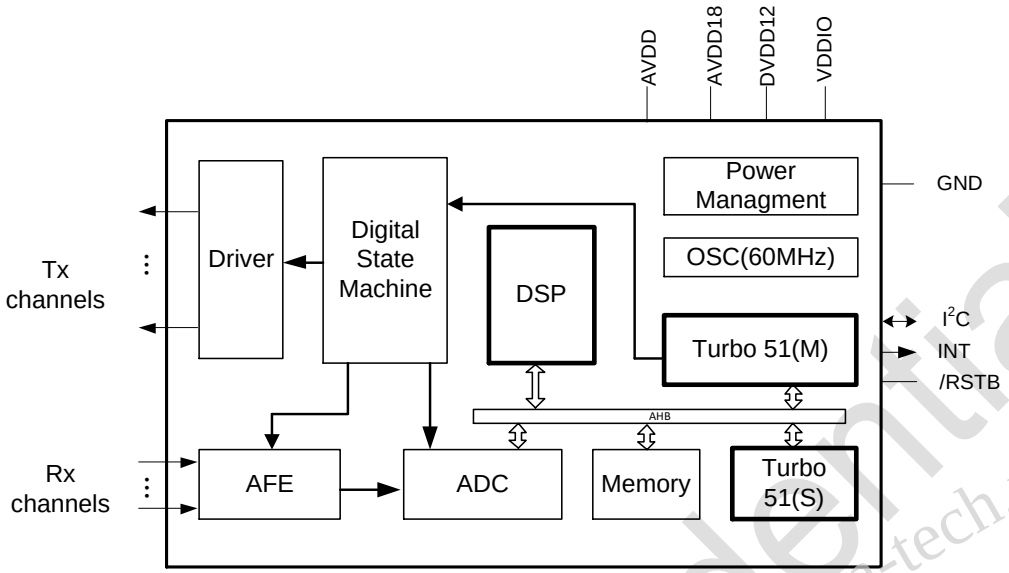
- Single supply(Typ.) : 2.8V/3.0V/3.3V

✧ Package: 100 pins, 14mm*14mm*1.0mm(package body), TQFP

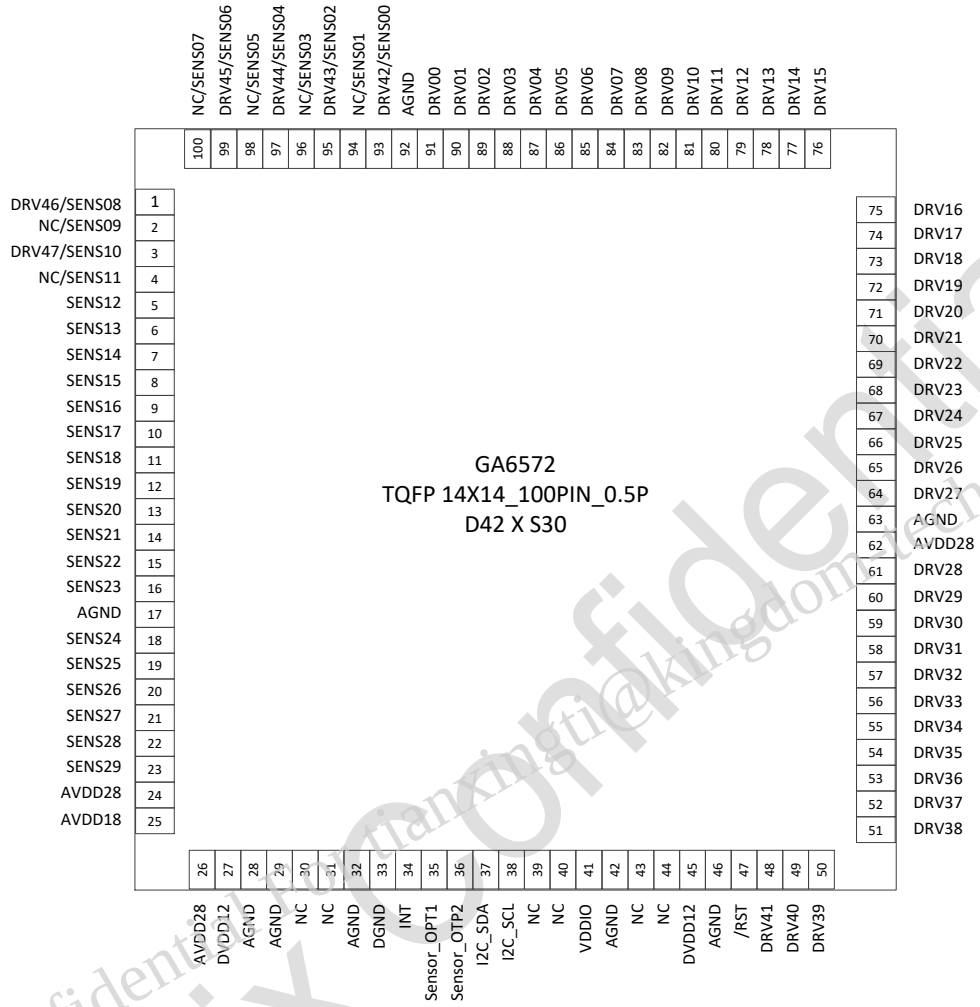
✧ Tools that support application development:

- Touch panel parameter detector and generator
- Touch panel performance tester
- Mass production test kit
- Reference driver code and guidedance files for host software development

3. Block Diagram



4. Pin Configurations



Pin No.	Name	Function description	Remarks
1	DRV46/SENS08	Transmitter electrode or receiver electrode	When Rx2Tx function is applied, this pin can be used as Tx; when Rx2Tx is not applied, this pin can be used as Rx
2	NC/SENS09	Floating or receiver	When Rx2Tx

		electrode	function is applied, this pin should be left floating; when Rx2Tx is not applied, this pin can be used as Rx
3	DRV47/SENS10	Transmitter electrode or receiver electrode	When Rx2Tx function is applied, this pin can be used as Tx; when Rx2Tx is not applied, this pin can be used as Rx
4	NC/SENS11	Floating or receiver electrode	When Rx2Tx function is applied, this pin should be left floating; when Rx2Tx is not applied, this pin can be used as Rx
5-16, 18-23	SENS12-SENS29	Receiver electrodes	
30,31,39,40,43,44	NC	Floating	
24,26,62	AVDD28	Analog power	2.2uF filter capacitor to GND

25	AVDD18		2.2uF filter capacitor to GND
27,45	DVDD12		2.2uF filter capacitor to GND
33	DGND	Digital signal ground	
34	INT	Interrupt signal	
35	Sensor_OPT1	Sensor ID pin 1	
36	Sensor_OPT2	Sensor ID pin 2	External pull-down resistor required
37	I2C_SDA	I^2C data signal	
38	I2C_SCL	I^2C clock signal	
41	VDDIO	Supply voltage of GPIO	2.2uF filter capacitor to GND Floating: 1.8V Connect to AVDD: AVDD
47	/RST	System reset pin	External 10KΩ pull-up resistor required, active-low reset
48-61,64-91	DRV00~DRV41	Transmitter electrodes	
17,28,29,32,42,46,63,92	AGND	Analog power ground	
93	DRV42/SENS00	Transmitter electrode or receiver electrode	When Rx2Tx function is applied, this pin can be used as Tx; when Rx2Tx is not applied, this pin can be

			used as Rx
94	NC/SENS01	Floating or receiver electrode	When Rx2Tx function is applied, this pin should be left floating; when Rx2Tx is not applied, this pin can be used as Rx
95	DRV43/SENS02	Transmitter electrode or receiver electrode	When Rx2Tx function is applied, this pin can be used as Tx; when Rx2Tx is not applied, this pin can be used as Rx
96	NC/SENS03	Floating or receiver electrode	When Rx2Tx function is applied, this pin should be left floating; when Rx2Tx is not applied, this pin can be used as Rx
97	DRV44/SENS04	Transmitter electrode or receiver electrode	When Rx2Tx function is

			applied, this pin can be used as Tx; when Rx2Tx is not applied, this pin can be used as Rx
98	NC/SENS05	Floating or receiver electrode	When Rx2Tx function is applied, this pin should be left floating; when Rx2Tx is not applied, this pin can be used as Rx
99	DRV45/SENS06	Transmitter electrode or receiver electrode	When Rx2Tx function is applied, this pin can be used as Tx; when Rx2Tx is not applied, this pin can be used as Rx
100	NC/SENS07	Floating or receiver electrode	When Rx2Tx function is applied, this pin should be left floating; when Rx2Tx is not

			applied, this pin can be used as Rx

5. Sensor Design

5.1 Layout of Rx Channels

SENS00 to SENS29 are 30 Rx channels on the chip directly connected to 30 ITO Rx electrodes on the sensor. After the layout of the Rx channels is determined, relevant registers of GA6572 shall be configured to ensure logic positions of Rx channels are consistent with their physical positions, so that the reported coordinates match the physical coordinates.

5.2 Layout of Tx Channels

DRV00 to DRV41 are 42 Tx channels on the chip directly connected to 42 ITO Tx electrodes on the sensor.

After the layout of the Tx channels is determined, relevant registers of GA6572 shall be configured to ensure logic positions of Tx channels are consistent with their physical positions, so that the reported coordinates match the physical coordinates.

Please refer to the toolChannel Selector for channel selection.

5.3 Sensor Design Specifications

The sensor design varies due to different stack-ups. For details of sensor design, please refer to “Goodix Sensor Design Guide” ,

5.4 Touch Key Design

GA6572 supports a maximum of 10 touch keys in the following two ways:

Touch Key Designed on sensor extension area:

1) Use Rx channel(s) as Common Line(s)
   a) Use one separate Rx channel (as common line) and 1 to 10 Tx channels to form at most 10 touch keys;
   b) Use two separate Rx channels (as common lines) and 1 to 5 Tx channels to form at most 10 touch keys;

The touch keys should share their Tx channel(s) with the touch screen.

2) Use Tx channel(s) as Common Line(s)

a) Use one separate Tx channel (as common line) and 1 to 10 Rx channels to form at most 10 touch keys;

b) Use two separate Tx channels (as common lines) and 1 to 5 Rx channels to form at most 10 touch keys.

The touch keys should share their Rx channel(s) with the touch screen.

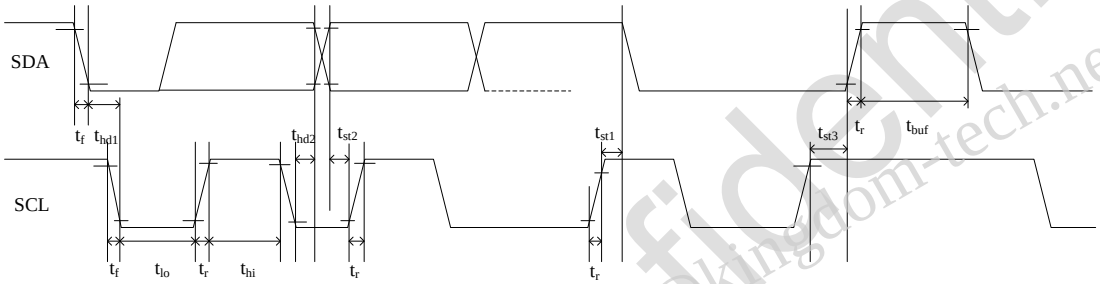
Touch key designed on Flexible Printed Circuit (FPC):

Channels selection rules for touche keys designed on FPC are the same as those for touch keys dsigned on sensor extension area a. Touch key pattern on FPC should be designed specifically.

6.I²C Communication

6.1 I²C Timing

GA6572 provides a standard I2C interface for SCL and SDA to communicate with the host. GA6572 always serves as slave device in the system with all communication being initialized by the host. It is strongly recommended that communication speed be kept at or below 400Kbps. The I2C timing is shown below:



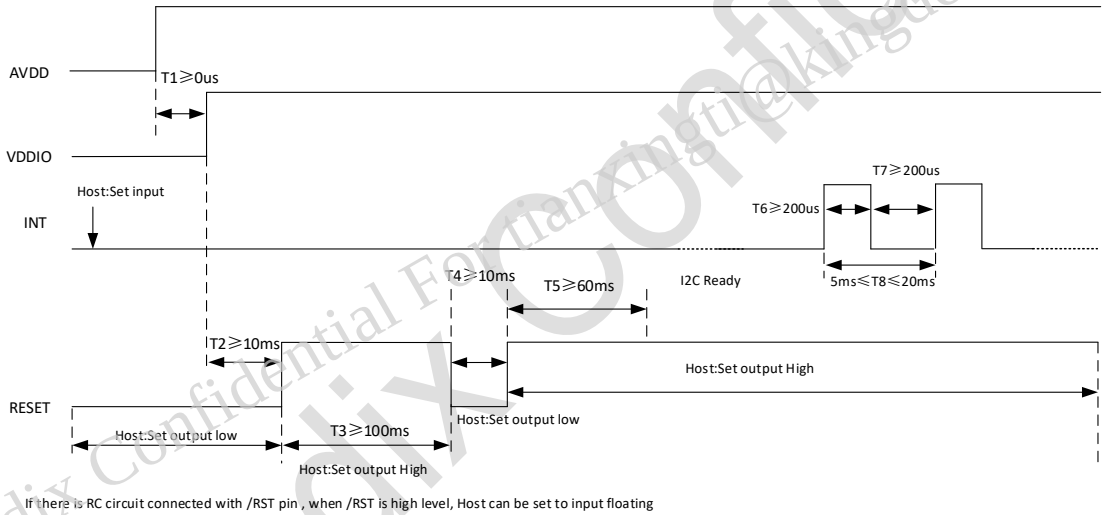
Test condition 1: 1.8V host interface voltage, 400Kbps communication speed**, 2KΩ pull-up resistor**

Parameter	Symbol	Min.	Max.	Unit
SCL low period	t_{lo}	1.3	-	us
SCL high period	t_{hi}	0.6	-	us
SCL setup time for Start condition	t_{st1}	0.6	-	us
SCL setup time for Stop condition	t_{st3}	0.6	-	us
SCL hold time for Start condition	t_{hd1}	0.6	-	us
SDA setup time	t_{st2}	0.1	-	us
SDA hold time	t_{hd2}	0	-	us

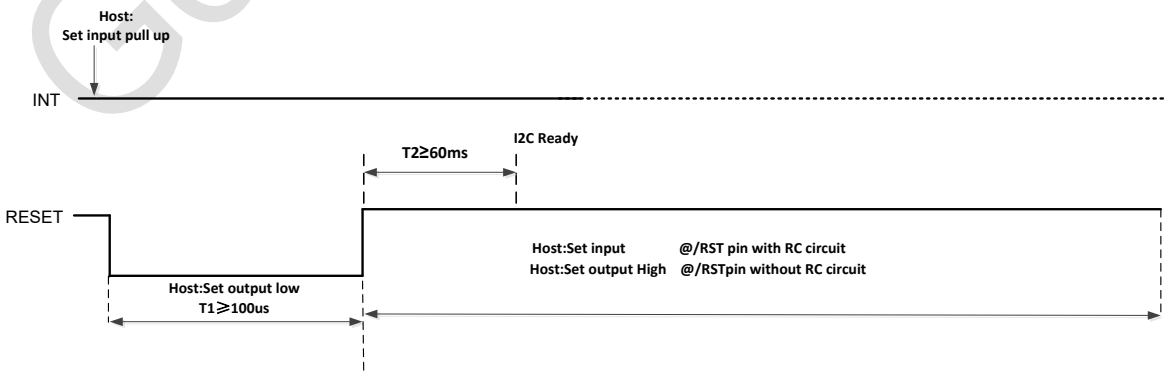
Test condition 2: 3.3V host interface voltage, 400Kbps communication speed**, 2KΩ pull-up resistor**

Parameter	Symbol	Min.	Max.	Unit
SCL low period	t_{lo}	1.3	-	us
SCL high period	t_{hi}	0.6	-	us
SCL setup time for Start condition	t_{st1}	0.6	-	us
SCL setup time for Stop condition	t_{st3}	0.6	-	us
SCL hold time for Start condition	t_{hd1}	0.6	-	us
SDA setup time	t_{st2}	0.1	-	us
SDA hold time	t_{hd2}	0	-	Us

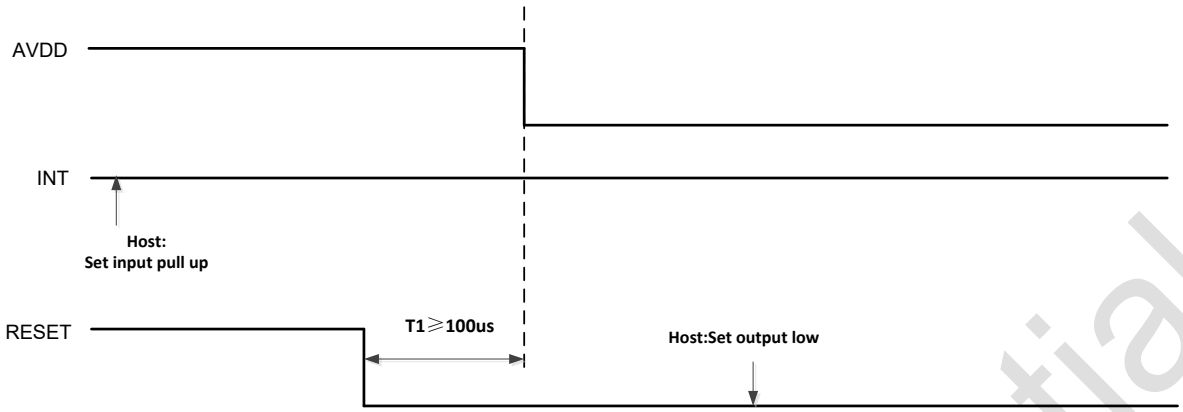
Power-on Timing：



Reset Timing (GA6572 reset by host)：



Power-Down Timing (GA6572 is powered down by the host)



a) Data Transmission

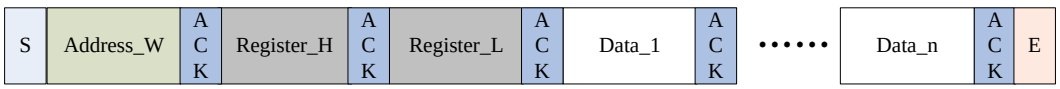
Communication is always initiated by the host. Valid Start condition is signaled by pulling SDA line from high to low when SCL line is high. Data flow or address is transmitted after the Start condition.

All slave devices connected to I^2C bus should detect the 8-bit address issued after Start condition and send the correct ACK. After receiving matching address, GA6572 acknowledges by configuring SDA line as output port and pulling SDA line low during the ninth SCL cycle. When receiving unmatched address, namely, not 0XBA or 0XBB, GA6572 will stay in an idle state.

For data bytes on SDA, each of 9 serial bits will be sent on nine SCL cycles. Each data byte consists of 8 valid data bits and one ACK or NACK bit sent by the recipient. The data transmission is valid when SCL line is high.

When communication is completed, the host will issue the Stop condition which implies the transition of SDA line from low to high when SCL line is high.

b) Writing Data to GA6572



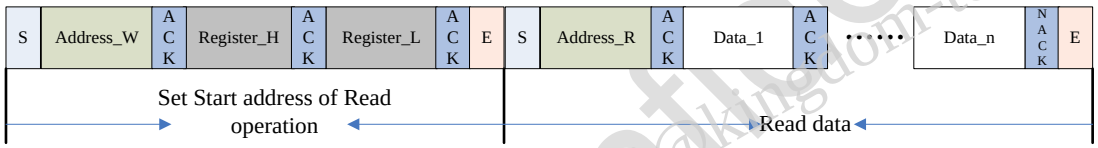
Timing for Write Operation

The diagram above displays the timing sequence of the host writing data onto GA6572. First, the host issues a Start condition. Then, the host sendsaddress bits and R/W bit.

After receiving ACK, the host sends the 16-bit register address (where writing starts) and the 8-bit data bytes (to be written onto the register).

The location of the register address pointer will automatically add 1 after every Write Operation. Therefore, when the host needs to perform Write Operations on a group of registers of continuous addresses, it is able to write continuously. The Write Operation is terminated when the host issues the Stop condition.

c) Reading Data from GA6572



Timing for Read Operation

The diagram above is the timing sequence of the host reading data from GA6572. First, the host issues a Start condition and sends 0XBA (address bits and R/W bit; R/W bit as 0 indicates Write operation) to the slave device.

After receiving ACK, the host sends the 16-bit register address (where reading starts) to the slave device. Then the host sets register addresses which need to be read.

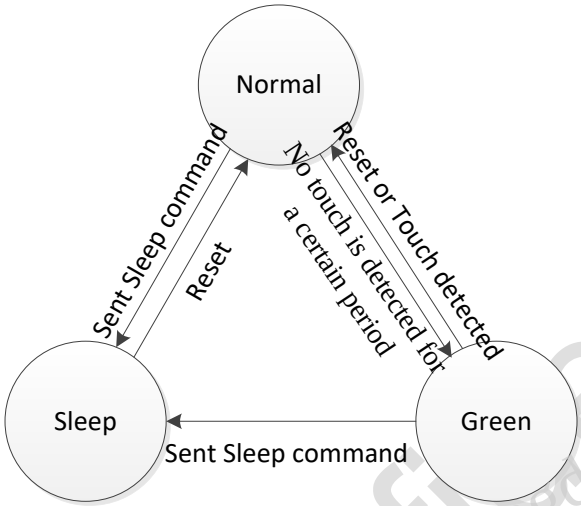
Also after receiving ACK, the host issues the Start condition once again and sends 0XBB (Read Operation). After receiving ACK, the host starts to read data.

GA6572 also supports continuous Read Operation and, by default, reads data continuously. Whenever receiving a byte of data, the host sends an ACK signal indicating successful reception. After receiving the last byte of data, the host sends a NACK signal followed by a STOP condition which terminates communication.

7.

7. Description on Functions

7.1 Operating Modes



a) Normal Mode

When GA6572 is operating in Normal mode, its coordinate refresh period is subject to configuration (5ms to 20ms valid, one step is 1ms).

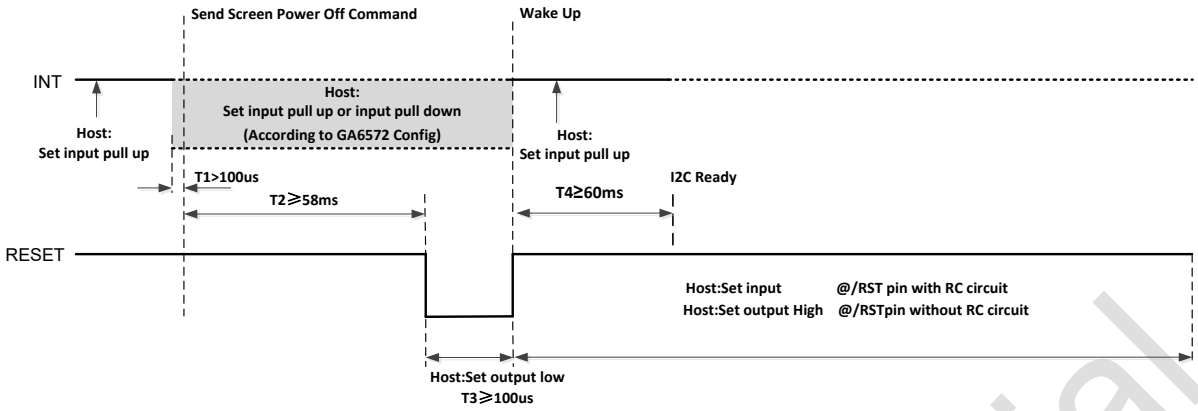
When no touch is detected for a certain period (0s to 15s, subject to configuration; one step is 1s) in Normal mode, GA6572 will automatically switch to Green mode to reduce power consumption.

b) Green Mode

In Green mode, the scan period for GA6572 is about 12ms. It automatically enters Normal mode if any touch is detected.

c) Sleep Mode

GA6572 enters Sleep mode if it receives the corresponding I^2C command from the host (It is necessary to set INT pin as input pull-up or input pull-down according to GA6572 configuration). GA6572 exits Sleep mode and enters Normal mode after the host resets GA6572 through /RST. The interval between sending screen-off command and wake-up should be longer than 58ms.

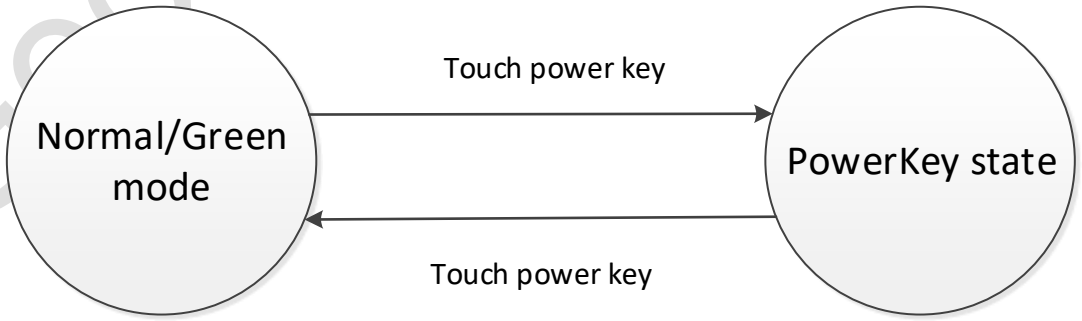


7.2 Interrupt Triggering Mechanism

When touched, GA6572 sends a pulse via INT pin in every scanning cycle to notify the host to read coordinates. Host will then set a triggering mechanism via relevant register “INT” bit. INT as “0” indicates rising edge-triggered, which means GA6572 will notify the host by driving INT output from low to high when operated by user; INT as “1” indicates falling edge-triggered, which means GA6572 will notify the host by driving INT output from high to low when operated by user .

7.3 PowerKey Function

One of GA6572 keys can be set as PowerKey. In Normal mode, once touched, PowerKey data will be reported to the host and the host will send control command to enable GA6572 to enter low power comsumption state. In low power comsumption state, if PowerKey is touched, GA6572 will trigger interrupt repeatedly to awake the system. The host needs to enable GA6572 to enter Normal mode again through pulling RST.



7.4 Rx2Tx Function

Some receiver electrodes of GA6572 can be converted to transmitter electrodes. This function is applicable

when the number of transmitter electrodes is more than 42 and the number of receiver electrodes is less than 30. Only 6 even-numbered receiver electrodes can be converted to transmitter electrodes: SENS00, SENS02, SENS04, SENS06, SENS08, and SENS10. And after the conversion, their adjacent odd-numbered electrodes (SENS01, SENS03, SENS05, SENS07, SENS09 and SENS11) must be left floating . Please refer to the pin definition in section 4 for details.

7.5 GA6572GA6572GA6572GA6572Stationary Configuration

GA6572 supports Stationary Configuration. After receiving configuration parameters from the host, GA6572 will fix parameters to the latest version. Once these parameters are fixed, GA6572 will communicate with the host solely via I2C bus and will not receive any parameters of previous versions from the host.

7.6 Self-calibration

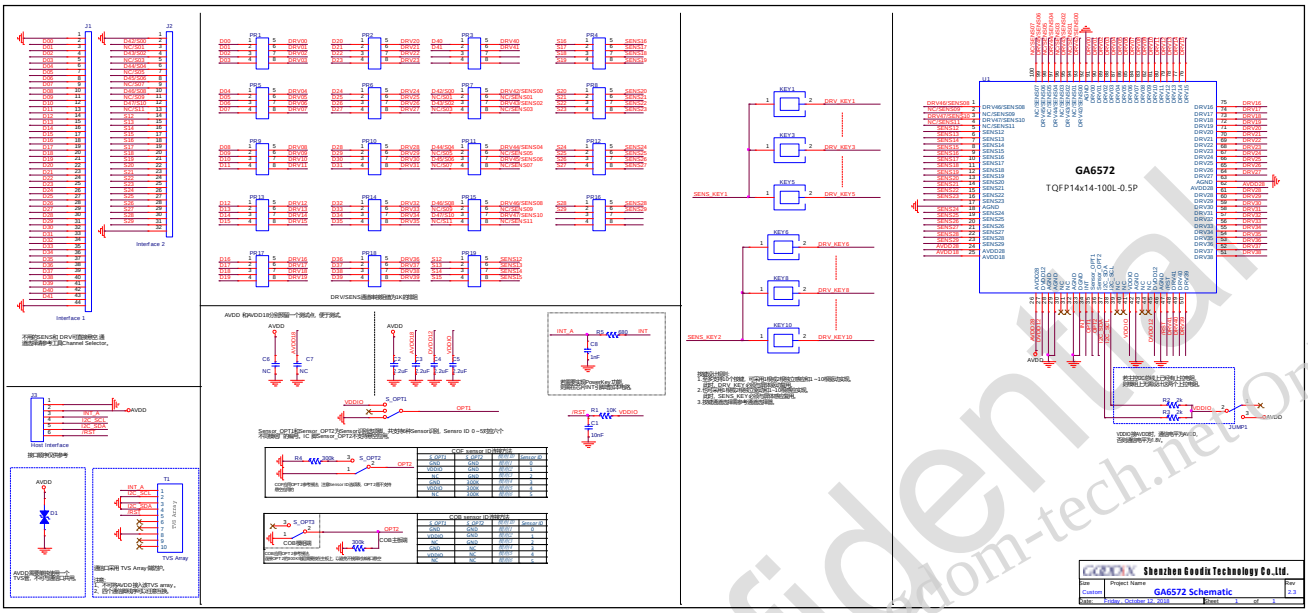
a) Self-calibration during Initialization

Fluctuations in temperature, humidity and environment may affect the baseline of the capacitive sensor in idle state. GA6572 will update detection baseline according to environmental conditions within the first 200 ms of initialization. Then, GA6572 will complete the initialization

b) Automatic Drift Compensation

Gradual changes in environmental factors such as temperature, humidity, or dust may also affect the baseline of the capacitive sensor in idle state. GA6572 will detect real-time changes in data and perform statistic analysis of historic data to revise the baseline and thus reduce the impact of environmental changes on the touch performance

8. Sample Schematic



GA6572 Sample Schematic

Note:

- This schematic only represents basic application. Adjustments may be required to fit in with actual situations and application environments.
- It is recommended that the capacitor be ceramic X7R.

9. Electrical Characteristics

9.1 Absolute Maximum Ratings

Parameter	Min.	Max.	Unit
Analog power AVDD28 (please refer to AGND)	-0.3	3.47	V
VDDIO (please refer to DGND)	-0.3	3.47	V
Voltage on digital I/O	-0.3	3.47	V
Voltage on analog I/O	-0.3	3.47	V
Storage temperature	-60	150	℃
ESD susceptibility (HBM)	±4		KV

9.2 Recommended Operating Conditions

Parameter	Min.	Typ.	Max.	Unit
AVDD28①	2.7	2.8/3.0/3.3	3.4	V
VDDIO②	-	1.8	-	V
Operating temperature	-40	25	105	℃

9.3 AC Electrical Characteristics

(Ambient temperature:25℃, AVDD28=2.8V, VDDIO=1.8V)

Parameter	Min.	Typ.	Max.	Unit
OSC oscillation frequency	59	60	61	MHz
I/O output rise time, low to high	-	14@100pf	-	ns
I/O output fall time, high to low	-	14@100pf	-	ns

① Power supply ripple Vpp≤100mV @ Typical AVDD28 supply voltage; Power supply ripple Vpp≤50mV @ Maximum or Minimum AVDD28 supply voltage.

② When VDDIO is floating, the logic level is 1.8V; when VDDIO is connected to AVDD28, the logic level is AVDD28.

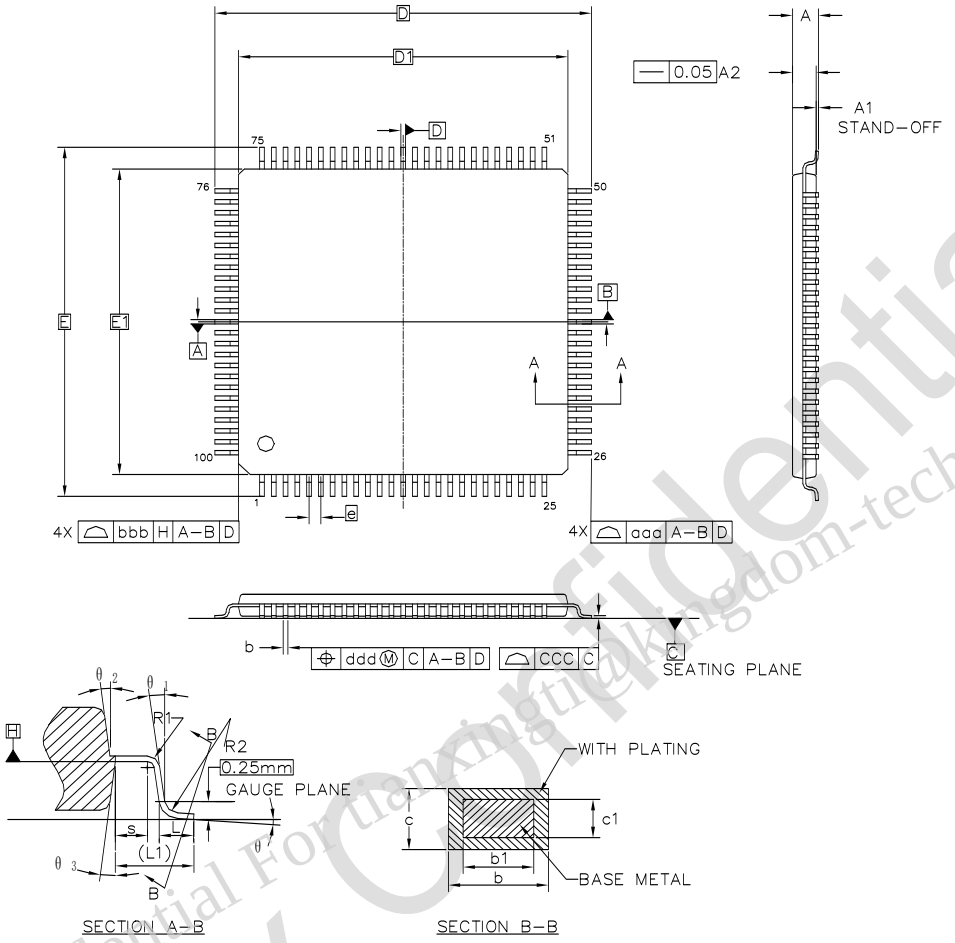
9.4 DC Electrical Characteristics

(Ambient temperature:25℃, AVDD28=2.8V, VDDIO=1.8V or VDDIO=AVDD28)

Parameter	Min.	Typ.	Max.	Unit
Normal mode operating current@100Hz	-	13	-	mA
Green mode operating current	-	11	-	mA
Sleep mode operating current	-	100	-	uA
Maximum transient current	-	25	-	mA
Digital input low voltage/VIL	-0.3	-	0.25*VDDIO	V
Digiral input high voltage/VIH	0.75*VDDIO	-	VDDIO+0.3	V
Digital output low voltage/VOL	-	-	0.15*VDDIO	V
Digital output high voltage/VOH	0.85*VDDIO	-	-	V

Note：In every mode, the actual current will vary due to the number of channels and firmware configuration.

10. Package



SYMBOL	MILLIMETER			INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	-	-	1.20	-	-	0.047
A1	0.05	-	0.15	0.002	-	0.006
A2	0.95	1.00	1.05	0.037	0.039	0.041
D	16.00 BSC.			0.630 BSC.		
D1	14.00 BSC.			0.552 BSC		
E	16.00 BSC.			0.630 BSC.		
E1	14.00 BSC.			0.552 BSC		
R2	0.08	-	0.20	0.003	-	0.008
R1	0.08	-	-	0.003	-	-
θ	0°	3.5°	7°	0°	3.5°	7°
θ_1	0°	-	-	0°	-	-
θ_2	11°	12°	13°	11°	12°	13°
θ_3	11°	12°	13°	11°	12°	13°
c	0.09	-	0.20	0.004	-	0.008
c 1	0.09	0.127	0.16	0.004	0.005	0.006
L	0.45	0.60	0.75	0.018	0.024	0.030
L_1	1.00 REF			0.039 REF		
S	0.20	-	-	0.008	-	-
b	0.17	0.22	0.27	0.007	-	0.011
b1	0.17	0.20	0.23	0.007	0.008	0.009
e	0.50 BSC.			0.020 BSC.		
aaa	0.20			0.008		
bbb	0.20			0.008		
ccc	0.08			0.003		
ddd	0.07			0.003		

11. Requirements on SMT Reflow Solder

11.1 Moisture Sensitivity Level (MSL)

GA6572 is classified as **MSL3**. The detailed requirements are listed below:

1) Calculated shelf life in sealed Moisture-Barrier Bag: 12 months at <40℃ and < 90% relative humidity (RH)

2) After bag is opened, devices that will be subjected to IR reflow solder or other high temperature process (<260℃) must be

   a) Mounted within: 168 hours of factory conditions ≤30℃/60% RH, OR

   b) Stored at < 10% RH (such as a dry cabinet)

3) Devices require bake, before mounting, if:

   a) Humidity indicator card is >20% when read at 23±5℃

   b) 2a or 2b not met

4) If baking is required:

   a) Devices shipped in low temperature carriers (such as Tape and Reel) can be baked in carriers for 192 hours at 40℃+5℃/-0℃ and <5% R.H.

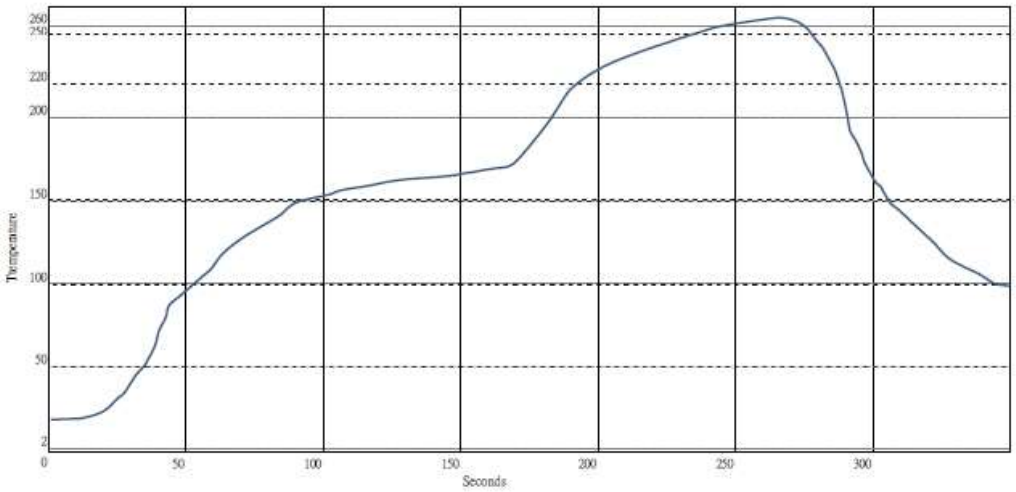
   b) Devices shipped in high temperature carriers (such as Tray) can be baked in carriers for 24 hours at 125°C +5/-0℃

   c) After baking, device should be put into the Moisture-Barrier Bag right after it cools down. Device shipped in low temperature carriers (such as Tape and Reel) should be packed inside the bag along with at least 5g desiccant and a six-spot humidity indicator card; Device shipped in high temperature carriers (such as Tray) should be packed inside the bag along with at least 10g desiccant and a six-spot humidity indicator card. Each bag should be vacuumized and sealed.

11.2 Reflow Passes

Number of reflow passes: ≤3.

11.3 Pb-Free Reflow Temperature Profile



GA6572 follows the standard J-STD-020D-01 and more particularly these parameters:

<table>
<tr><th colspan="5">Profile Feature</th><th colspan="3">Pb-Free Assembly (For reference)</th></tr>
<tr><td rowspan="8">Room Temperature to Peak Temperature</td><td colspan="2" rowspan="2">A . Pre-heating zone (25℃-150℃)</td><td>Duration</td><td colspan="2">80s-120s</td><td rowspan="8">The time spent on ramping up from room temperature to peak temperature should be less than 8 minutes.</td></tr>
<tr><td>Ramp Up Rate</td><td colspan="2"><3℃/s</td></tr>
<tr><td colspan="2" rowspan="2">B. Flat-Temperature zone (150℃-200℃)</td><td>Duration</td><td colspan="2">60s-120s (100s is recommended by Goodix)</td></tr>
<tr><td>Ramp Up Rate</td><td colspan="2"><1℃/s</td></tr>
<tr><td rowspan="4">Time Above 217℃</td><td rowspan="2">C. 217℃-260℃</td><td>Duration</td><td>60s-85s</td><td rowspan="4">Time above 217℃: 60s-150s</td></tr>
<tr><td>Ramp Up Rate</td><td><3℃/s</td></tr>
<tr><td>D. Peak Temp. (255℃-260℃)</td><td>Duration</td><td>20s-30s</td></tr>
<tr><td rowspan="2">E .260℃-217℃</td><td>Duration</td><td>60s-75s</td><td>--</td></tr>
<tr><td>--</td><td>--</td><td>Ramp Down Rate</td><td><6℃/s</td><td>--</td></tr>
<tr><td>--</td><td colspan="2">F. Time Below 217℃ (Cooling zone)</td><td>Ramp Down Rate</td><td colspan="2">1 ℃/s-3℃/s</td><td>--</td></tr>
</table>

Note: Please follow the standard “J-STD-020D-01”.

12. Revision History

Revision	Date	Description
0.1	2017-07-21	Preliminary release
0.2	2017-11-10	Updated pin definition. Updated touch key design. Updated operating modes. Updated Power on Timing. Updated sample schematic; Updated Package.
0.3	2017-11-14	Updated sample schematic;
0.4	2017-11-21	Updated Package.
1.0	2017-12-29	Updated sample schematic; Updated green mode operating current.
1.1	2018-03-09	Updated Power on Timing. Updated sample schematic;
1.2	2018-04-04	Updated the support inch of touch screen.
1.3	2018-04-11	Updated the support inch of touch screen.
1.4	2018-05-15	Modified description on sensor design; Updated sample schematic; Updated package.
1.5	2018-08-23	Adds PowerKey function Adds Rx2Tx function Modified pin definition Updated sample schematic Updated the package drawing Added description in section “Overview” and “Features” Updated diagrams of I2C timing
1.6	2018-10-17	Updated sample schematic
1.7	2020-09-08	Modified the diagram of power-on timing

13. Contact Information

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