LOW POWER
TOUCH SENSOR

The Best Touch Sensor Solution!

GREENCHIP

GreenTouch3LP^{TM} GTX301L
Capacitive Touch Sensor

DATASHEET
VER4.00

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1. INTRODUCTION

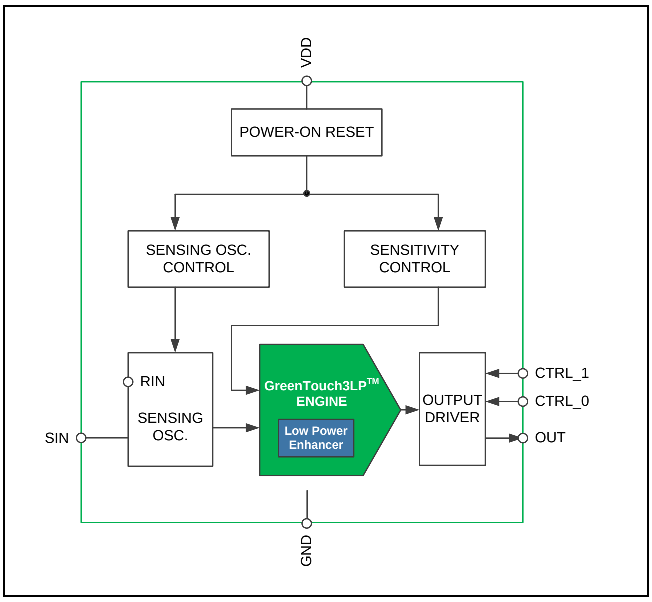
The GTX301L is one of the GreenTouch3LP^{TM} capacitive touch sensor series. Especially the GTX301L can do capacitance sensing with 1 channel under above GreenTouch3LP^{TM} engine operation. Thanks to the GreenTouch3LP^{TM} low power engine, a variety of battery powered applications can increase product usage time. Also based on the technology of the existing GreenTouch3^{TM} engine, reliability can be secured against various noise and environmental changes.

The GTX301L can be applied under wide supply voltage range from 1.8V to 5.5V.

2. FEATURES

- 1 channel cap. sensing input
- Embedded GreenTouch3LP^{TM} Engine
  - Analog compensation circuit
  - Embedded digital noise filter
  - Intelligent sensitivity calibration
  - Low power enhancer
- 1:1 direct output
  - Push-pull type
  - Active low / high function
  - Toggle function
- Wide supply voltage range: 1.8V to 5.5V
  - Single supply operation
- Package type
  - SOT23-6L (2.92x1.60x1.10, e=0.95)
  - DFN-6L (2.00x2.00x0.75, e=0.65)
- RoHS compliant

3. BLOCK DIAGRAM



4. APPLICATIONS

- Multi key application – Door lock, Remote controller and Etc.
- Portable Electronics - Mobile phone, MP3, PMP, PDA, Navigation, Digital Camera, Video Camera and Etc.
- Multimedia Devices - Digital photo frame, Home theater system and Etc.

5. ORDERING INFORMATION

Part No.	Package
GTX301L-ST	SOT23-6L (2.92x1.60x1.10, e=0.95)
GTX301L-DN	DFN-6L (2.00x2.00x0.75, e=0.65)

6. MARKING INFORMATION

KYYWW

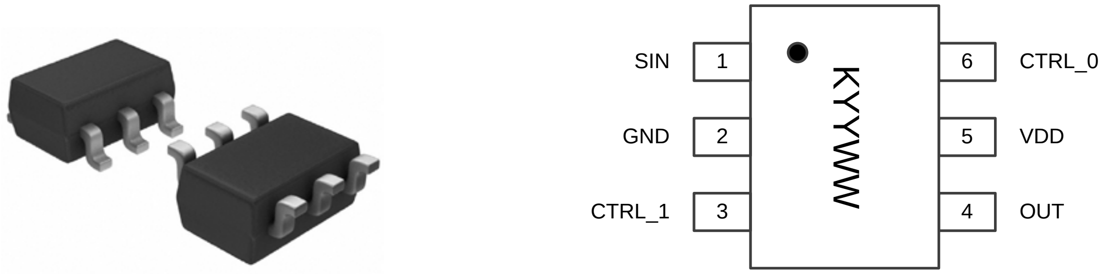
K: Device Code
YY: Year Code (ex> 16:2016, 17:2017)
WW: Week Code

7. PIN DESCRIPTION

This section describes the pin names and pin functions of GTX301L. Pinout configuration also illustrated as below. The GTX301L device is available in the following packages.

7.1 SOT23-6L PACKAGE

7.1.1 PACKAGE INFORMATION



(TOP view)

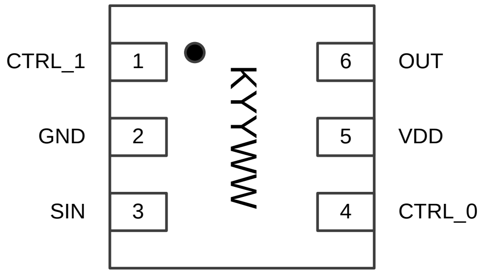
7.1.2 PIN CONFIGURATION

No.	Name	Type	Description
1	SIN	AO	Touch sensing input
2	GND	GND	Ground connection
3	CTRL_1	AO/DI	CTRL_1 Option (Refer to CTRL OPTION SELECTION)
4	OUT	DO	1:1 Direct output for touch detection (Push-pull Type)
5	VDD	PWR	Supply Voltage
6	CTRL_0	AO/DI	CTRL_0 Option (Refer to CTRL OPTION SELECTION)

NOTE: DI: Digital Input, DO: Digital Output, DIO: Digital Input and Output, AI: Analog Input, AO: Analog Output, PWR: POWER

7.2 DFN-6L PACKAGE

7.2.1 PACKAGE INFORMATION



(TOP view)

7.2.2 PIN CONFIGURATION

No.	Name	Type	Description
1	CTRL_1	AO/DI	CTRL_1 Option (Refer to CTRL OPTION SELECTION)
2	GND	GND	Ground connection
3	SIN	AO	Touch sensing input
4	CTRL_0	AO/DI	CTRL_0 Option (Refer to CTRL OPTION SELECTION)
5	VDD	PWR	Supply Voltage
6	OUT	DO	1:1 Direct output for touch detection (Push-pull Type)

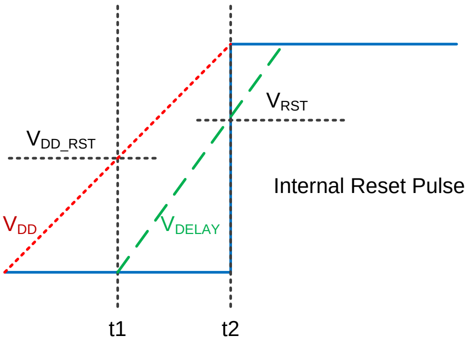
NOTE: DI: Digital Input, DO: Digital Output, DIO: Digital Input and Output, AI: Analog Input, AO: Analog Output, PWR: POWER

8. FUNCTION DESCRIPTION

8.1 INTERNAL RESET

The GT301L has internal power reset functions. The internal reset operation is used for initial power reset.

The internal power reset sequence is represented as below.



The internal V_{DELAY} voltage starts to rise when VDD come up to V_{DD_RST} level. The internal reset pulse is maintained as low between t1 and t2. During this low pulse period, the internal power reset operation is finished. Every time when VDD drops under V_{DD_RST} internal reset block makes V_{DELAY} signal low and then internal reset pulse drops to low. By above internal reset operation sequence GTX301L gets more certain and more correct power reset function than any others.

8.2 IMPLEMENTATION FOR TOUCH SENSING (SIN)

SIN input and internal sensing reference (RIN) input are used for touch detection of capacitance variation sensing. The SIN input pin is connected to touch sensing pad and catches capacitance variation caused by direct touch or approach. The GTX301L compares each capacitance of SIN input and that of internal sensing reference (RIN) input and determines touch detection of each channel when capacitance of each SIN input increases.

The GTX301L also has various intelligent sensing functions to determine valid touch from error or sensitivity problems caused by various environmental noise effects. These advanced sensing methods will help making faultless touch key systems under the worst conditions.

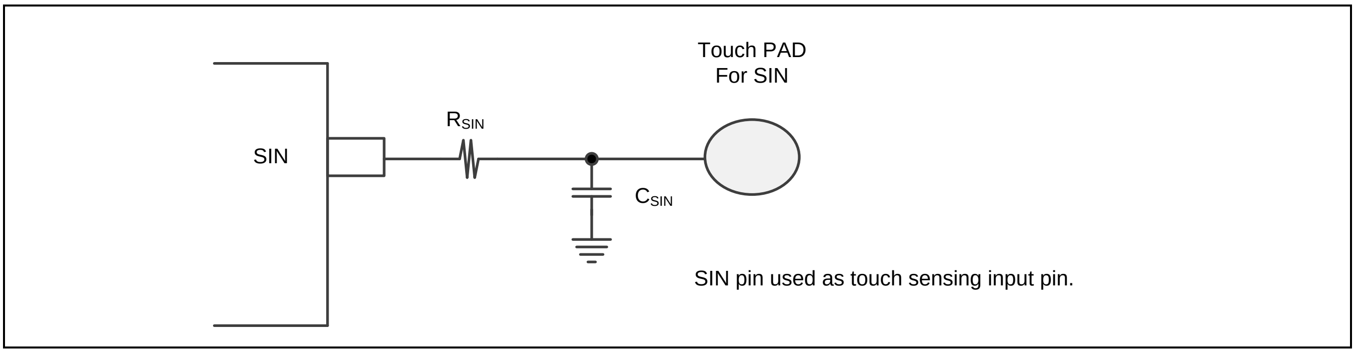
The internal intelligent sensitivity adjustment algorithm removes sensitivity rolling caused by system noise, circuit deviation, and circumstantial drift. The GTX301L has a special noise elimination filter for more powerful noise rejection and it will be very helpful for proper touch operation even if the system operates under deteriorative environment conditions.

The GTX301L SIN input has an internal series resistor for ESD protection. The additional external series resistors are profitable for prevention of abnormal actions caused by radiation noise or electrical surge pulse.

In any case, if the additional external series resistor (R_{SIN}) of SIN input is required, then it should be less than 1.5KΩ to SIN and the location of resister is recommended as closer to the SIN pin. For C_{SIN} capacitor, less than 50pF capacitor can be used.

The SIN input routing lines are desirable to be routed as short as possible and the width of routing lines should be as narrow as possible and should be placed on bottom metal. In other words, a touch PAD and other parts should be placed on different metal each other. The SIN input line is desirable to be routed as far as possible from impedance varying path such as LED drive current path. All touch sensing pads are recommended to be surrounded by GND pattern in order to reduce noise influence.

Implementation circuit for SIN pin is shown in the following figure.

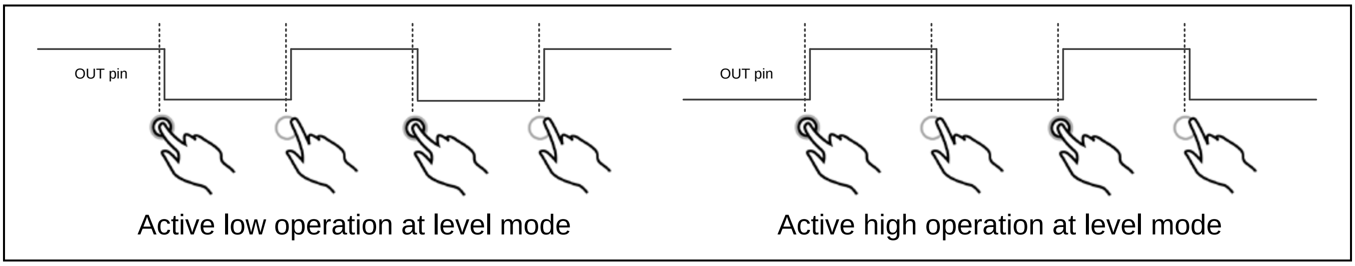


8.3 1:1 DIRECT OUTPUT (OUT)

The GTX301L has OUT pin for 1:1 direct output interface. OUT pin can operate in active low or active high mode. Its polarity of output can be changed with CTRL_1 and CTRL_0 options. The OUT pin have push-pull type output so therefore it does not needs pull-up and pull-down resisters.

Toggle output mode is useful at lighting system on/off key switch application. For instance first touch can make light on output signal via OUT pin of the GTX301L and this output signal maintains same light on states until next touch occurs.

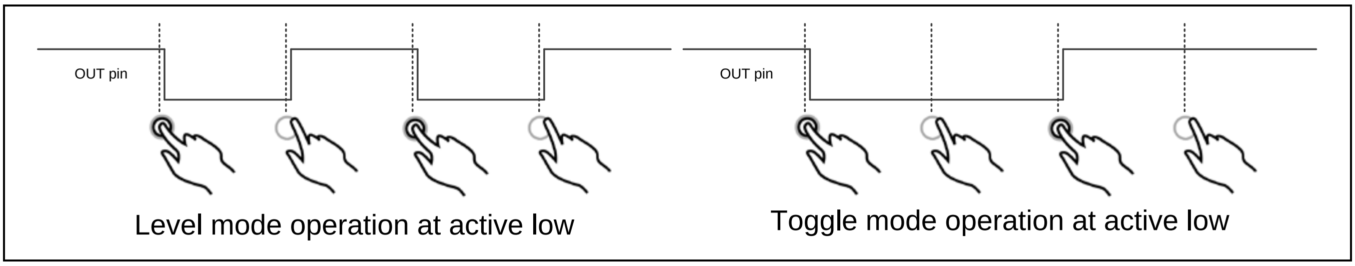
The OUT pin waveform for active low and high operation



Active low operation at level mode

Active high operation at level mode

The OUT pin waveform for level and toggle operation



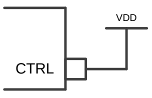
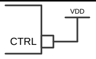
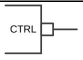
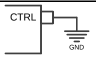
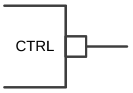
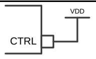
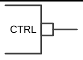
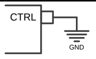
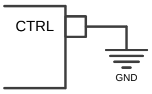
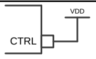
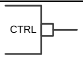
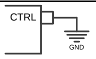
Level mode operation at active low

Toggle mode operation at active low

8.4 CTRL OPTION SELECTION (CTRL_1, CTRL_0)

In the GTX301L, nine options are available by each of CTRL_1 and CTRL_0 pins connection. Each option and its connections are shown in the table and figures below. This CTRL pulse signal starts at internal power reset time and finishes after a few operation period and options setting.

Each options and respective connection are shown in the following table for CTRL_1 and CTRL_0 pins.

CTRL_1	CTRL_0	Output Polarity	Output Mode	Idle Time	Typical Application
 VDD	 VDD	Active high	Level	200msec	Fingerprint recognition
	 OPEN	Active low	Level	200msec	
	 GND	Active high	Level	300msec	
 OPEN	 VDD	Active low	toggle	50msec	Normal touch button
	 OPEN	Active low	Level	50msec	
	 GND	Active low	Level	100msec	
 GND	 VDD	Active low	Level	50msec	In-ear detection (earphone)
	 OPEN	Active low	Level	100msec	
	 GND	Active low	Level	200msec	

9. ELECTRICAL CHARACTERISTICS

9.1 ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Conditions	Min	Typ.	Max	Units
Maximum supply voltage	V_{DD_MAX}		-0.3		6.0	V
Supply voltage range(1)	V_{DD_RNG}		-0.3		6.0	V
Voltage on any input pin	V_{IN_MAX}		-0.3		VDD +0.3	V
Maximum current into any pin	I_{MIO}		-100		100	mA
Power dissipation	P_{MAX}		-		800	mW
Storage temperature	T_{STG}		-65		150	℃
Operating humidity	H_{OP}	8 hours	5		95	%
Operating temperature	T_{OPR}		-40		85	℃
Junction temperature	T_J		-40		125	℃

NOTE: (1) This is the real valid power supply voltage range considering allowable supply tolerance. It cannot be used as target supply voltage range which is separately presented at below I/O ELECTRICAL CHRACTERISTICS.

9.2 I/O ELECTRICAL CHARACTERISTICS

This section includes information about power supply requirements and I/O pin characteristics.

(TA = -25 to 85°C, V_{DD} = 1.8V to 5.5V)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Target supply voltage	V_{DD}		1.8	3.0 / 5.0	5.5	V
Current consumption	I_{DD} (VDD=3.0V)	Standby mode @IDLE_TIME=300msec$^{(1)}$	-	5.5	-	uA
		Standby mode @IDLE_TIME=200 msec$^{(1)}$	-	6	-	uA
		Standby mode @IDLE_TIME=100 msec$^{(1)}$	-	7.5	-	uA
		Standby mode @IDLE_TIME=50 msec$^{(1)}$	-	10	-	uA
	I_{DD} (VDD=5.0V)	Standby mode @IDLE_TIME=300 msec$^{(1)}$	-	17	-	uA
		Standby mode @IDLE_TIME=200 msec$^{(1)}$	-	18	-	uA
		Standby mode @IDLE_TIME=100 msec$^{(1)}$	-	20	-	uA
		Standby mode @IDLE_TIME=50 msec$^{(1)}$	-	23	-	uA
Input high voltage	V_{IH}	All input pins	0.7VDD	-	VDD + 0.3	V
Input low voltage	V_{IL}	All input pins	-0.3	-	0.3VDD	V
Output high voltage	V_{OH}	All output pins (I_{OH}= -4mA, VDD = 5.0V)	VDD - 0.4	-	-	V
Output low voltage	V_{VOL}	All output pins (I_{OL}= 10mA, VDD = 5.0V)	-	-	0.4	V
Output source current$^{(2)}$	I_{SRC}	All output pins (Active high)	-	-	-4	mA
Output sink current$^{(2)}$	I_{SINK}	All output pins (Active low)	-	-	10	mA

Output low leakage current	I_{LOL}		-	-	-1	uA
Output high leakage current	I_{LOH}		-	-	1	uA

NOTE:

(1) Refer to CTRL OPTION SELECTION

(2) Test condition: VDD = 3.0V, TA = 25℃ and normal operation mode (Unless otherwise noted)

9.3 RESET CHARACTERISTICS

(TA = -25 to 85°C, V_{DD} = 1.8V to 5.5V)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
POR(1) Time	t_{POR}		-	-	600	usec
POR voltage	V_{POR}		-	1.5	-	V

NOTE: (1) POR = Internal Power-On Reset

9.4 SENSING INPUT CHARACTERISTICS

(TA = -25 to 85°C, V_{DD} = 1.8V to 5.5V)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Minimum detectable input capacitance variant	ΔC_{S_MIN}		0.1	-	-	pF
Maximum input external capacitance	C_{EXT_MAX}		-	-	100	pF
Sense OSC internal series resistor	R_{INT}		-	140	-	Ω

NOTE: It's recommended that external capacitance (C_{EXT_MAX}) can be used less than 40pF capacitor in CTRL_1=VDD option.

9.5 SYSTEM CHARACTERISTICS

(TA = -25 to 85°C, V_{DD} = 1.8V to 5.5V)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Time for stable Touch Operating after Reset	t_{OP}		100	-	-	msec
Touch On response time	t_{ON}		-	80	-	msec

9.6 ESD CHARACTERISTICS

Qualification tests are performed to ensure that these devices can withstand exposure to reasonable levels of static without suffering any permanent damage. During the device qualification, ESD stresses were performed for the Human Body Model (HBM), the Machine Model (MM) and the Charge Device Model (CDM).

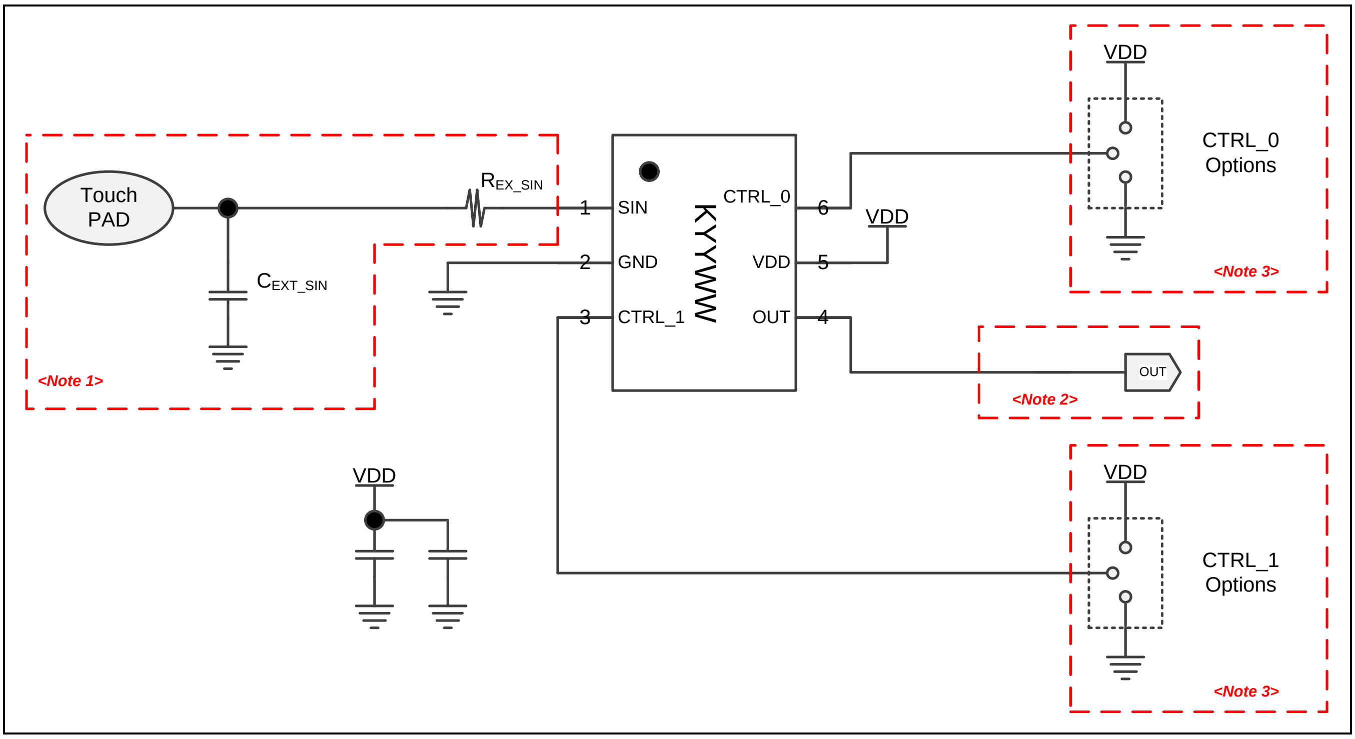
Test Mode	Symbol	Test Pin (Reference)	Max	Unit	Reference Document
Human body model (HBM)	V_{HBM}	VSS, I/O (VDD)	±8000	V	JS-001-2014
		VDD, I/O (VSS)	±8000	V	
		Every I/O (All I/O)	±8000	V	
Machine model (MM)	V_{MM}	VSS, I/O (VDD)	±600	V	JESD22-A115C :2010
		VDD, I/O (VSS)	±800	V	
		Every I/O (All I/O)	±700	V	
Charge device model (CDM)	V_{CDM}	Every Pin	±2000	V	JESD22-C101F :2013

9.7 LATCH-UP CHARACTERISTICS

Test Type	Symbol	Polarity	Max	Unit	Reference Document
I test	I_{LAT_POS}	Positive	200	mA	JESD78E :2016
	I_{LAT_NEG}	Negative	200	mA	
V_{supply} over V_{DD_MAX}	V_{LAT_POS}	Positive	8.25	V	

10. APPLICATION

10.1 EXAMPLE CIRCUIT (SOT23-6L PACKAGE)


Touch PAD
R_{EX_SIN}
C_{EXT_SIN}
<Note 1>
1 SIN
2 GND
3 CTRL_1
CTRL_0 6
VDD 5
OUT 4
KYYWW
VDD
CTRL_0 Options
<Note 3>
OUT
<Note 2>
CTRL_1 Options
<Note 3>

NOTE: R_{EXT_SIN} = 560Ω (recommend), C_{EXT_SIN} = 1pF (recommend)

NOTE: The values of resistance and capacitance can be changed depending on the application set.

NOTE: It is recommended to make empty space on PCB artwork for install the capacitance later, currently even if the capacitance is not needed on the SIN port.

10.2 APPLICATION NOTES

Normally a touch sensing operation is ultimately impedance variation sensing. Hence a touch sensing system is recommended to be taken care of prevention of the external sensing disturbance. Although the GTX301L has enough noise rejection algorithms and various protection circuits to prevent error touch detection caused by noise and incapable sensing, it is better to take care in noisy applications such as home appliances. There are many measurable or invisible noises in system that can affect the impedance sensing signal or distort that signal. The main principal design issues and required attentions are such as below.

- **Power Line**
  - The touch sensor power line is recommended to be split from the other power lines such as relay circuits or LED power that can make pulsation noise on power lines.
  - The big inductance that might exist in long power connection line can cause power fluctuation by other noise sources.
  - The lower frequency periodic power noise such as a few Hz ~ kHz has more baneful influence on sensitivity calibration.
  - An extra regulator for touch sensor is desirable for prevention above power line noises.
  - The V_{DD} under shooting pulse less than internal reset voltage (V_{DD_RST}) can cause system reset.
  - The capacitor connected between V_{DD} and GND is somehow obligation element for buffering above power line noises. This capacitor must be placed as near to IC as possible.

- **Sensing Input Line for Touch Detect <Note1>**
  - The sensing lines for touch detection are desirable to be routed as short as possible and the width of routing path should be as narrow as possible.
  - The sensing line for touch detection should be formed by bottom metal, in other words, an opposite metal of a touch PAD.
  - SIN capacitor is useful for sensitivity reduction adjust. A bigger capacitor of SIN makes sensitivity of corresponding channel to be lower.
  - The sensing line for touch detection is desirable to be routed as far as possible from impedance varying path such as LED drive current path.
  - Additional external series resistors are profitable for prevention of abnormal actions caused by radiation noise or electrical surge pulse. The location of resister is better as near as possible to the SIN pin for better stable operation.

    (Refer to IMPLEMENTATION FOR TOUCH SENSING)

  - All touch sensing pads are recommended to be surrounded by GND pattern to reduce noise influence.

- **1:1 Direct Output Applications <Note2>**
  - The pin that is used for 1:1 direct output has an active low and high output mode. Both output modes are all push-pull type. The OUT pin corresponds to SIN sense input respectively.

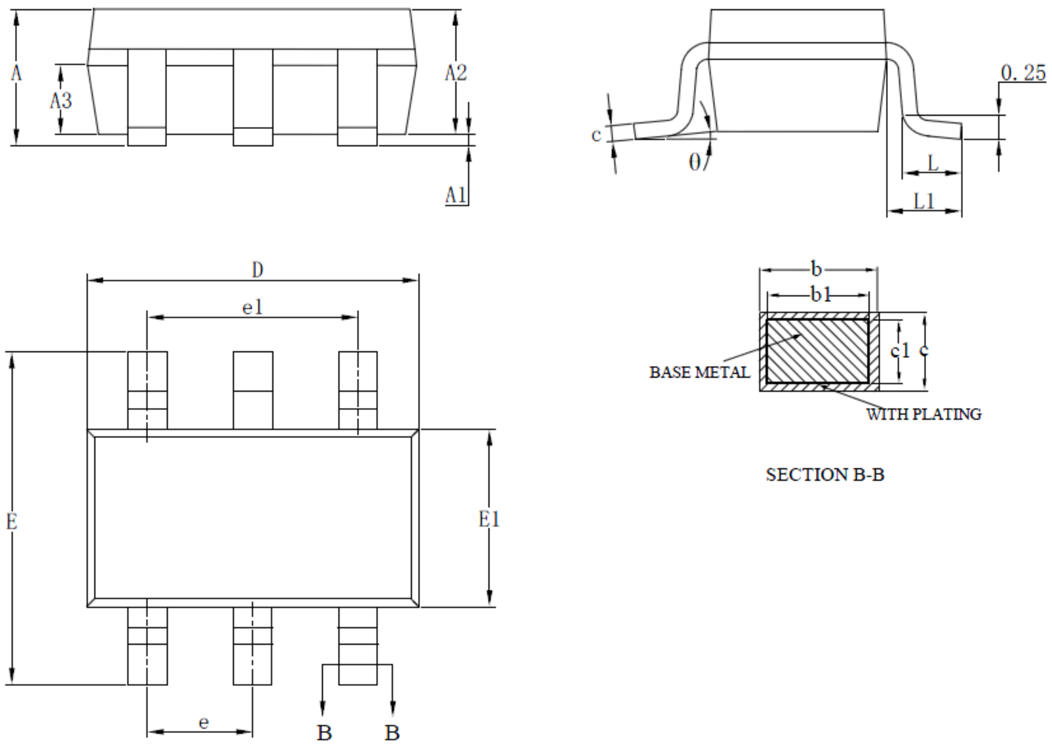
    (Refer to 1:1 DIRECT OUTPUT)

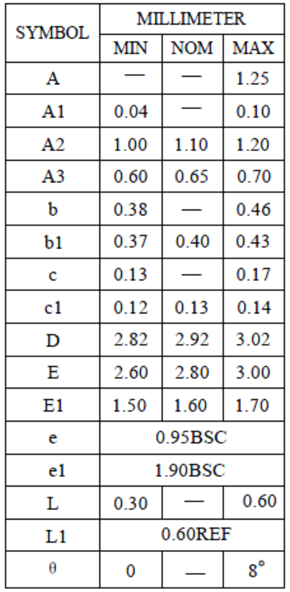
- **CTRL_1 and CTRL_0 Option Selection <Note3>**
  - Nine options are available by each of CTRL_1 and CTRL_0 pins connection.

    (Refer to CTRL OPTION SELECTION)

11. PACKAGE DIMENSION

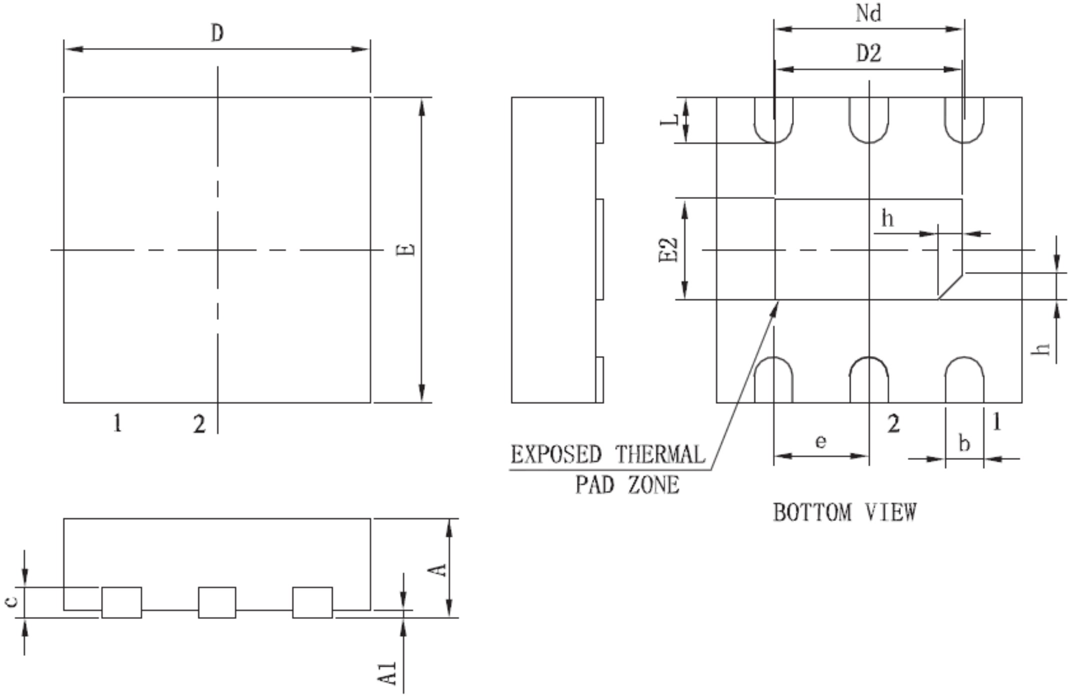
11.1 SOT23-6L PACKAGE


A
A3
A2
A1
c
θ
0. 25
L
L1
D
e1
E
E1
e
B
B
b
b1
c1
c
BASE METAL
WITH PLATING
SECTION B-B



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.25
A1	0.04	—	0.10
A2	1.00	1.10	1.20
A3	0.60	0.65	0.70
b	0.38	—	0.46
b1	0.37	0.40	0.43
c	0.13	—	0.17
c1	0.12	0.13	0.14
D	2.82	2.92	3.02
E	2.60	2.80	3.00
E1	1.50	1.60	1.70
e	0.95BSC		
e1	1.90BSC		
L	0.30	—	0.60
L1	0.60REF		
θ	0	—	8°

11.2 DFN-6L PACKAGE


D
E
1
2
Nd
D2
L
E2
h
h
e
2
b
1
EXPOSED THERMAL PAD ZONE
BOTTOM VIEW
c
A
A1

SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0. 70	0.75	0. 80
A1	—	0.02	0. 05
b	0. 25	0.30	0. 35
c	0. 18	0.20	0. 25
D	1. 95	2. 00	2. 05
D2	1. 00	1. 23	1. 45
e	0. 65BSC		
Nd	1. 30BSC		
E	1. 95	2. 00	2. 05
E2	0. 50	0. 68	0. 85
L	0. 25	0.30	0. 40
h	0. 10	0. 15	0. 20
载体尺寸（mil）	63*43		