



九齊科技股份有限公司  
Nyquest Technology Co., Ltd.

DATA SHEET

# NY9TS02A

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## 2 Keys Capacitive-Touch Controller of Low Stand-by Current

**Version 1.2**

**Mar. 26, 2019**

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## Revision History

<i>Version</i>	<i>Date</i>	<i>Description</i>	<i>Modified Page</i>
1.0	2018/08/27	Formal release.	-
1.1	2018/10/11	Modify I <sub>OP</sub> value.	6
1.2	2019/03/26	Remove SOT23-6.	-

## 1. 概述

NY9TS02A 為單晶片電容式觸摸感應的CMOS控制器，它是嵌入式OTP (One Time Programmable) 架構，提供2個觸摸鍵、2個CMOS輸出和2個開汲極(Open-Drain)輸出。利用內置的32KHz RC震盪，可以不需外加震盪電阻。內建LDO穩壓器來提供穩定的電源給電容式觸摸偵測。自動的觸摸鍵靈敏度校正功能(Auto-Judge Calibration)會自動校正環境變數。若當前有觸摸鍵被按住一段時間，強制的觸摸鍵靈敏度校正功能(Enforce Calibration)則會強制進行校正環境變數。另外，還內建一個慢速模式以降低耗電，在按鍵離開後可大幅度的節省功耗。支援特殊的ICP (In Circuit Programming) 燒錄功能，以方便客戶先組裝PCBA模組再進行燒錄。用戶可藉由九齊創新的開發軟體 "Q-Touch" 來開發不同的觸摸應用。

## 2. 功能

- (1). 寬廣的工作電壓：1.8V ~ 6.0V。
- (2). 掃描觸摸鍵時的待機電流非常低，可減少耗電。(I<sub>SB</sub> < 2uA @VDD=3.0V)
- (3). 32KHz內阻振盪。(±10% 誤差)
- (4). 2個觸摸鍵，提供兩種觸摸鍵選項：單鍵觸摸、兩鍵觸摸，可以經由 OTP fuse 來設定。在單鍵觸摸時，觸摸TP1可以控制所有4個輸出腳的輸出(O1, O2, O1N, O2N)；在兩鍵觸摸時，觸摸TP1和TP2則分別控制2個輸出腳的輸出(O1, O1N 和 O2, O2N)
- (5). 2個CMOS輸出和2個開汲極(Open-Drain)輸出，提供四種輸出模式選項：Level/Hold、On/Off、0.5ms pulse 和 32ms pulse 鍵觸摸和兩鍵觸摸，可以經由 OTP fuse 來設定。另外，輸出高電平(Busy\_High)和輸出低電平(Busy\_Low)也可以經由 OTP fuse 來設定。
- (6). 觸摸鍵靈敏度可以使用 "Q-Touch" 軟體開發工具來完成，並經由 OTP fuse 來設定。
- (7). 自動校正功能(Auto-Judge Calibration)可提供精準的觸摸按鍵偵測以避免環境改變，但校正時若有觸摸鍵被按住，則會自動終止校正程序。強制校正功能(Enforce Calibration)是在觸摸鍵被長時間按住，則會強制進行校正環境變數。提供兩種組合選項：0.5秒自動校正配合2秒強制校正、4秒自動校正配合40秒強制校正，可以經由 OTP fuse 來設定。
- (8). 2種觸摸鍵掃描模式：一般模式(Normal mode)和慢速模式(Slow mode)。在一般模式時，會進行依序掃描，可以減少觸摸偵測時間，但比較耗電。而在慢速模式時，會進行分時掃描，可以減少耗電但需要較長的喚醒時間，此時最長的觸摸偵測時間為72ms，最短的觸摸偵測時間為25ms。當觸摸離開之後等待1秒或12秒的時間會進入慢速模式，可經由 OTP fuse 來設定。
- (9). 內建LDO穩壓器(2.1V)，以提供穩定的電源來避免靈敏度異常導致偵測錯誤。
- (10). 提供低壓復位功能。(LVR=1.7V)
- (11). 支援特殊的ICP (In Circuit Programming) 燒錄功能，以方便客戶先組裝PCBA模組再進行燒錄。
- (12). 提供多種出貨型態，以滿足客戶不同的應用需求。

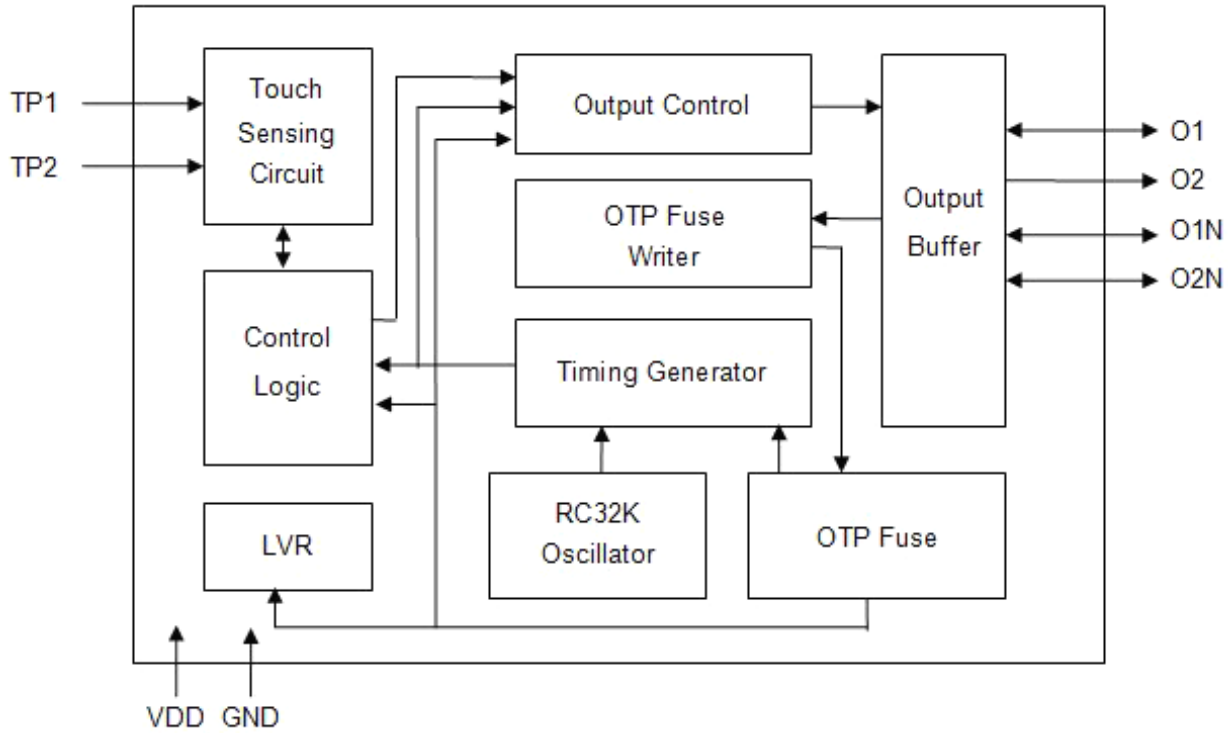
## 1. GENERAL DESCRIPTION

The NY9TS02A is a single-chip capacitive-touch CMOS IC. It is an embedded OTP (One Time Programmable) architecture with 2 touch keys, 2 CMOS output and 2 open-drain output pins. Each output can provide 4 kinds of output type cooperating with embedded OTP fuse option. Through the RC 32KHz internal oscillation, an external resistor is not required. A built-in LDO regulator can provide a stable capacitive sensing design. The Auto-Judge calibration is also built-in to adjust the environment changing to fit the sensitivity. If an abnormal touch key pressed for a long time, Enforce calibration will happen to release key. Furthermore, it is designed to save power consumption at slow scan mode after key release. A special *ICP* (in circuit programming) writing function is supported for embedded OTP fuse to fabricate PCBA in advance. An innovative software tool “*Q-Touch*” is provided to develop the different touch applications.

## 2. FEATURES

- (1). Wide operating voltage range: 1.8V ~ 6.0V.
- (2). Very low standby current for Touch-Key scan to reduce the power consumption. ( $I_{SB} < 2\mu A @ VDD=3.0V$ )
- (3). 32KHz oscillator with built-in resistor  $R_{osc}$  for operating mode. (+/- 10% tolerance)
- (4). 2 kinds of Touch-Key option: 1 key and 2 keys can be configured by OTP fuse. If 1 key is selected, TP1 can control all 4 outputs of O1, O2, O1N and O2N. If 2 keys are selected, TP1 and TP2 can control 2 outputs of O1 / O1N and O2 / O2N respectively.
- (5). 2 CMOS output and 2 open-drain output. There are 4 kinds of output mode: Level/Hold, On/Off, 0.5ms pulse and 32ms pulse, which can be configured by embedded OTP fuse. In addition, Busy\_High or Busy\_Low output level can be also configured by OTP fuse.
- (6). Touch sensitivity threshold can be detected from “*Q-Touch*” software and configured by OTP fuse.
- (7). Auto-Judge calibration function of Touch-Key is provided for touch accuracy to prevent the environment change, and calibration will be stopped when key is pressed. Enforce calibration function of Touch-Key occurs when key is pressed for a long time. There are 2 kinds of calibration combination: 0.5 seconds Auto-Judge with 2 seconds Enforce calibration and 4 seconds Auto-Judge with 40 seconds Enforce calibration can be configured by OTP fuse.
- (8). 2 kinds of scan mode for Touch-Key: normal mode and slow mode. At normal mode, sequential scan every 8ms when any key detected. Oppositely, at slow mode, longer sequential scan every 48ms to reduce power consumption. And the maximum key detect time is 72ms, and the minimum is 25ms. It will change to slow mode when no key detected after 1 second or 12 seconds configured by OTP fuse.
- (9). Built-in LDO regulator (2.1V) for a stable power that avoids the abnormal sensitivity and false detection.
- (10). Low Voltage Reset (LVR=1.7V) is supported to protect the system.
- (11). A special *ICP* (In Circuit Programming) writing function is supported for user to fabricate PCBA in advance.
- (12). Various shipping type for different application requirement.

### 3. BLOCK DIAGRAM



### 4. PAD DESCRIPTION

Pad Name	ATTR.	Description
VDD	Power	Positive power.
GND	Power	Negative power.
TP1	I/O	Touch-Key 1.
TP2	I/O	Touch-Key 2.
O1 / Vpp	I/O	CMOS output 1 for TP1, or positive high power at programming mode.
O2 / SDO	O	CMOS output 2 for TP2, or serial data output at programming mode.
O1N / SCK	I/O	NMOS open-drain output 1 for TP1, or serial clock input at programming mode.
O2N / SDI	I/O	NMOS open-drain output 2 for TP2, or serial data input at programming mode.

### 5. DEVELOPMENT, DEMONSTRATION & PRODUCTION

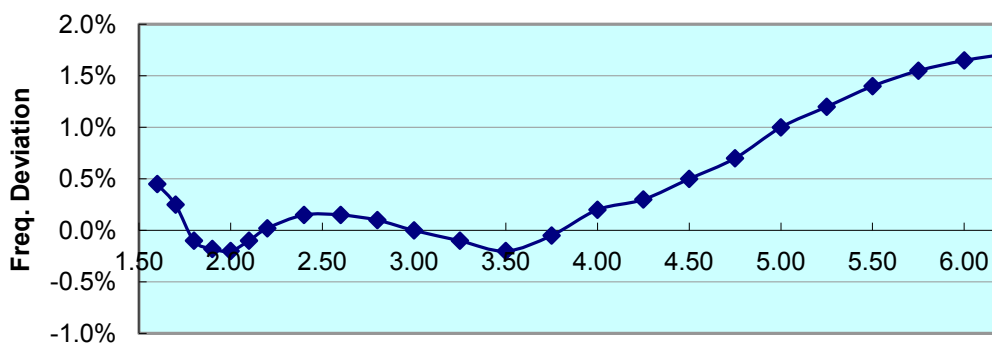
User can use “Q-Touch” software and NY9T\_ICE hardware to develop the desired functions. After finishing the code programming, user will get 2 files of “.bin” and “.htm”, the binary file and function check list. Through “OTP\_Writer” operation, user can download the “.bin” file into NY9TS02A OTP chip to demonstrate the function. Customer can make pilot production by NY9TS02A OTP directly, or can send the “.bin” file to Nyquest to release code for OTP pre-programming. For more details, please refer to “Q-Touch” user manual.

**6. ABSOLUTE MAXIMUM RATING**

Symbol	Parameter	Rated Value	Unit
$V_{DD} - V_{SS}$	Supply voltage	-0.5 ~ +6.5	V
$V_{IN}$	Input voltage	$V_{SS}-0.3V \sim V_{DD}+0.3$	V
$T_{OP}$	Operating Temperature	0 ~ +70	°C
$T_{ST}$	Storage Temperature	-25 ~ +85	°C

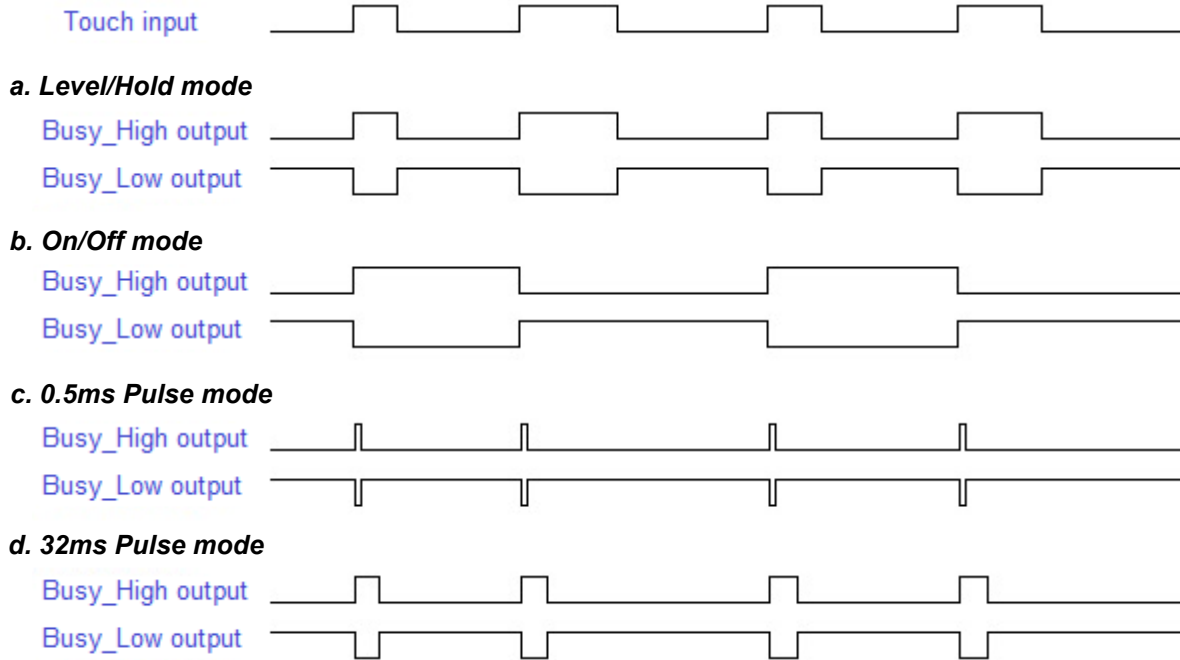
**7. DC CHARACTERISTICS** (Auto-Judge Calibration Period = 4s,  $T_A=25^\circ\text{C}$ , unless otherwise specified)

Symbol	Parameter	VDD	Min.	Typ.	Max.	Unit	Condition
$V_{DD}$	Operating voltage		1.8	3.0	6.0	V	32KHz
$I_{SB}$	Supply Current	Standby mode	3	1.6		uA	1 Touch-Key scan
			4.5	2.8			
			3	1.9			2 Touch-Keys scan
			4.5	3.2			
$I_{OP}$	Supply Current	Operating mode	3	6.0		uA	1 Touch-Key (No load)
			4.5	9.0			
			3	8.5			2 Touch-Keys (No load)
			4.5	11.5			
$I_{OH}$	Output drive current	3		-10		mA	$V_{OH} = 2.0V$
		4.5		-16			$V_{OH} = 3.5V$
$I_{OL}$	Output sink current (O1, O2)	3		20		mA	$V_{OL} = 1.0V$
		4.5		30			$V_{OL} = 1.0V$
	Output sink current (O1N, O2N)	3		30		mA	$V_{OL} = 1.0V$
		4.5		42			$V_{OL} = 1.0V$
$\Delta F/F$	Frequency deviation by voltage drop	3		0.2		%	$\frac{F_{osc}(3.0v) - F_{osc}(2.0v)}{F_{osc}(3.0v)}$
		4.5		0.5			$\frac{F_{osc}(4.5v) - F_{osc}(3.0v)}{F_{osc}(4.5v)}$
	Frequency lot deviation	--	-10		10	%	$\frac{F_{max}(V_{DD}) - F_{min}(V_{DD})}{F_{max}(V_{DD})}$
$F_{osc}$	Oscillation Frequency	--	28	32	36	KHz	$V_{DD} = 1.8\sim 6.0V$

**Voltage vs Freq. Deviation (32KHz@3V)**


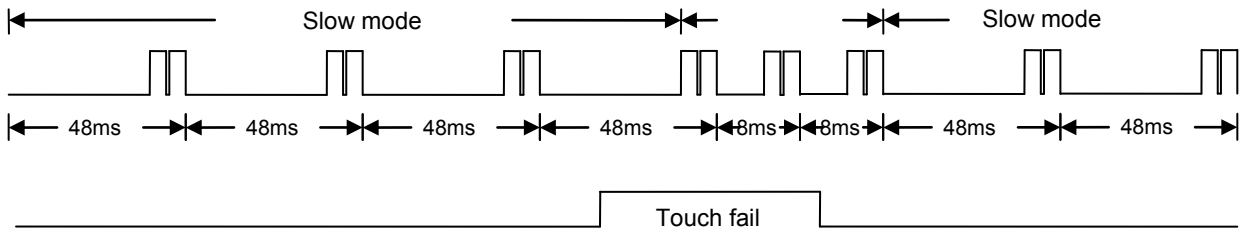
**8. TIMMING DIAGRAM**

**(1) Output Signal (O1, O2, O1N, O2N)**

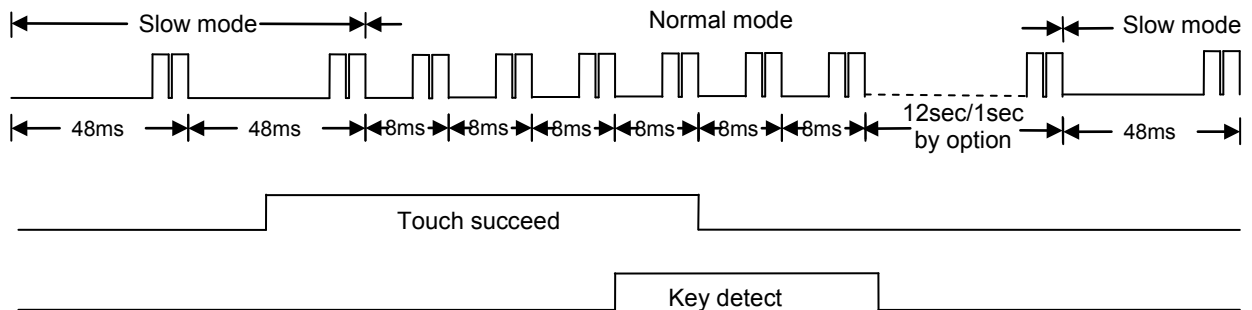


**(2) Touch Trigger (TP1, TP2)**

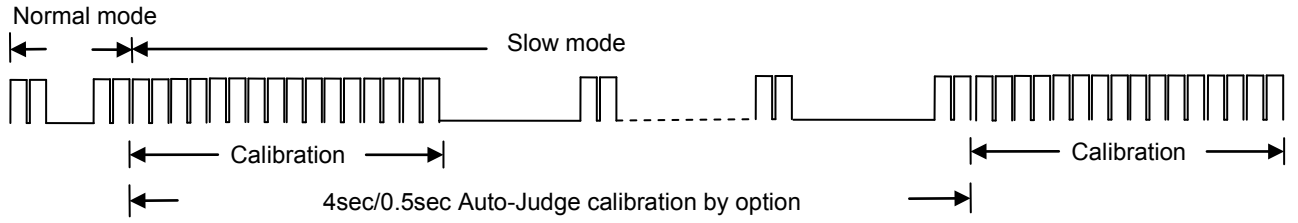
**a. Failed Trigger**



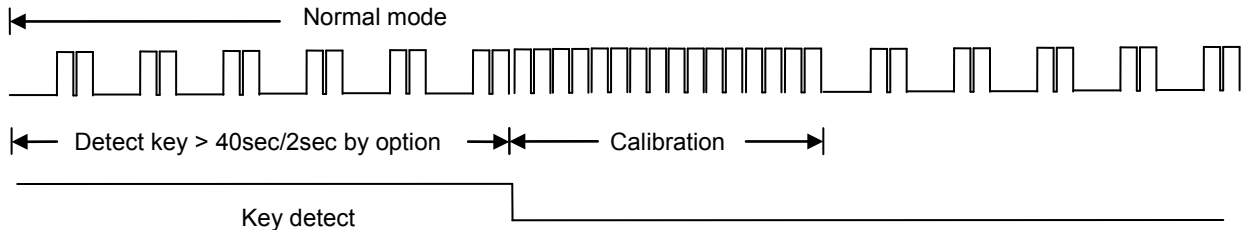
**b. Successful Trigger**



**(3) Auto-Judge Calibration**



**(4) Enforce Calibration**



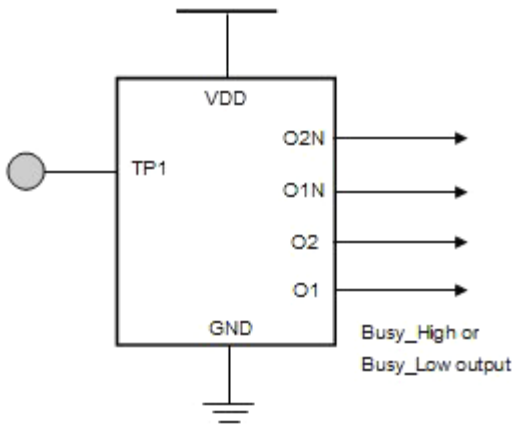
**9. CONFIGURATION BITS**

<i>Item</i>	<i>Name</i>	<i>Options</i>
1	Touch-Keys (1-bit)	a. <u>1 key</u> (TP1)    b. <u>2 keys</u> (TP1, TP2)
2	Output Modes (2-bit)	a. <u>Level/Hold</u> b. <u>On/Off</u> c. <u>0.5ms Pulse</u> d. <u>32ms Pulse</u>
3	Output Level (1-bit)	a. <u>Busy High</u> b. <u>Busy Low</u>
4	Touch Sensitivity (6-bit)	Difference count: 4, 6, ..., 122, 124, 126
5	Auto-Judge / Enforce / Slow Mode (1-bit)	a. <u>0.5s / 2s / 1s</u> b. <u>4s / 40s / 12s</u>

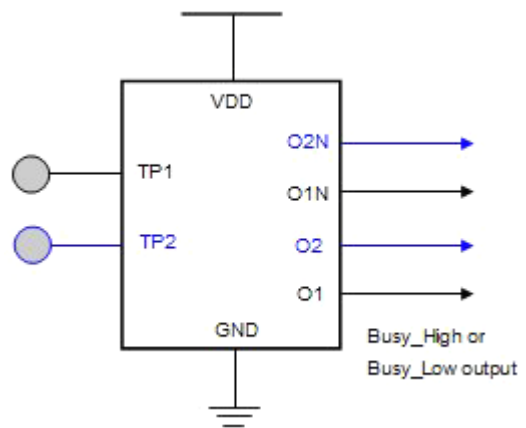


**10. APPLICATION**

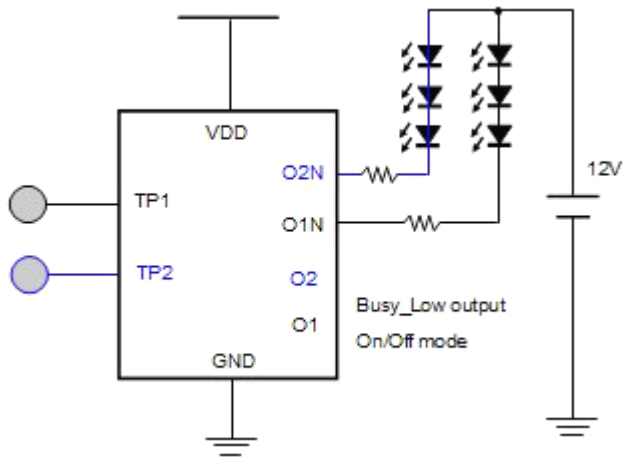
**(1) 1 Touch-Key Control**



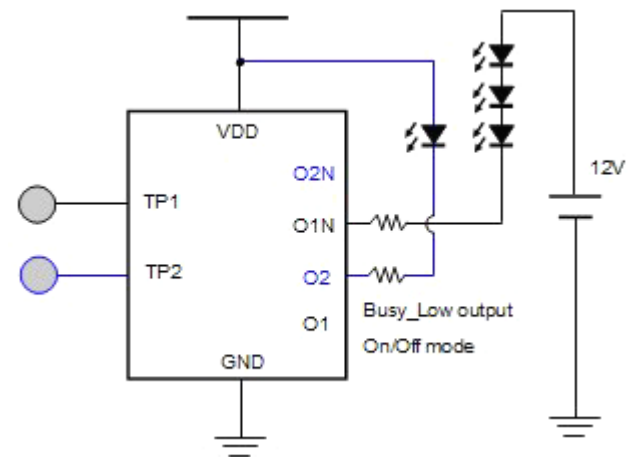
**(2) 2 Touch-Keys Control**



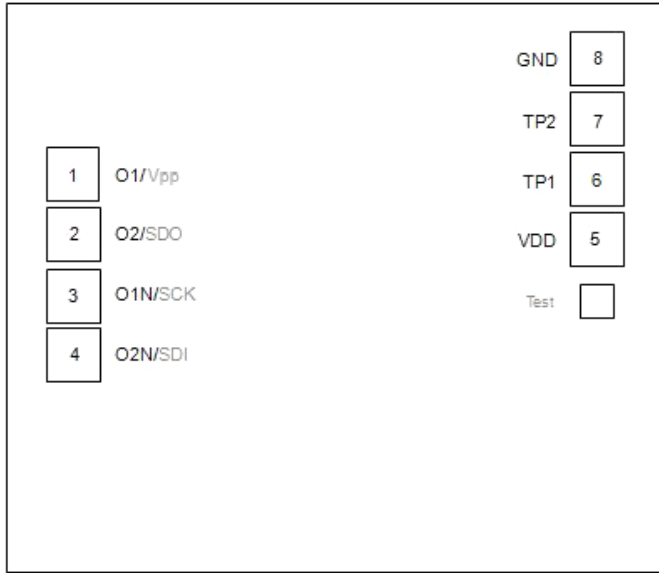
**(3) 2 Touch-Keys control two 12V Light Bar**



**(4) 2 Touch-Keys control one LED and one 12V Light Bar**

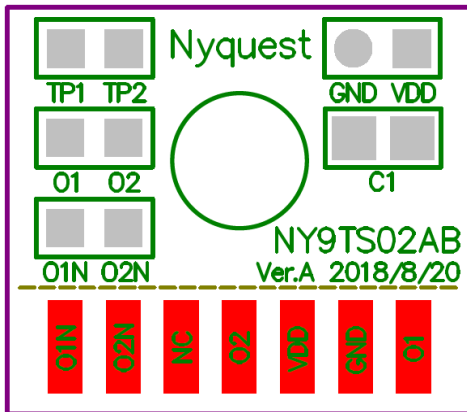


**11. DIE PAD DIAGRAM**

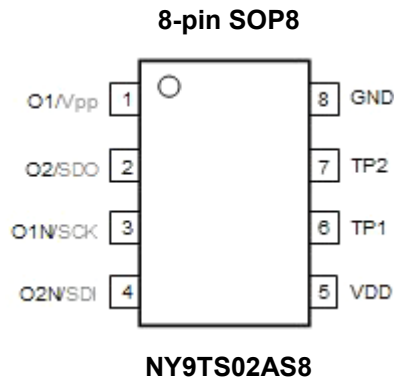


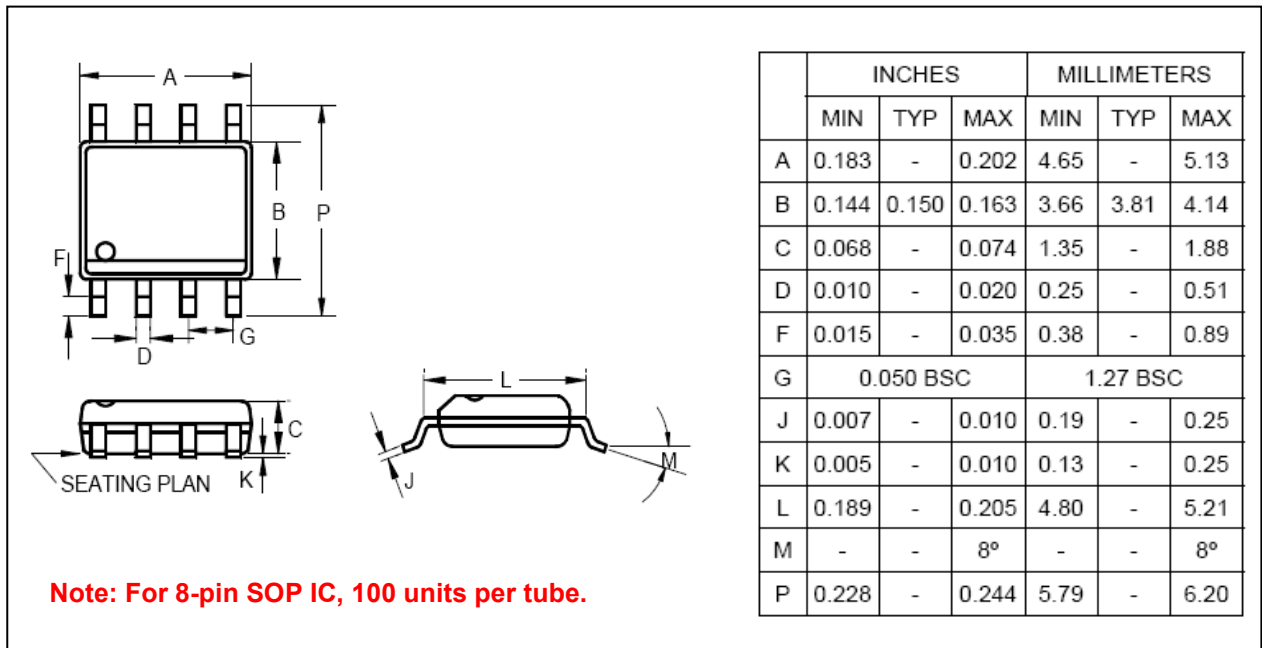
\* The IC substrate must be connected to GND or Floating.

**12. COB PIN ASSIGNMENT**



**13. PACKAGE PIN ASSIGNMENT**



**14. PACKAGE DIMENSION**
**14.1 8-Pin Plastic SOP (150 mil)**

**15. ORDERING INFORMATION**

<b>P/N</b>	<b>Shipping Type</b>	<b>Remarks</b>
NY9TS02A	Die	Blank OTP
NY9TS02A-xxxx *1	Die	Programmed OTP
NY9TS02AB	COB	20.3 mm x 11.9 mm (20.3 mm x 17.2 mm w/ V-Cut)
NY9TS02AS8	SOP-8	Width 150 mil, <u>Tape &amp; Reel</u> : 2.5K pcs per Reel <u>Tube</u> : 100 pcs per Tube

\*1 "xxxx": Code number.

\*2 "xxxxy": Code number + Package pinout.