Touch Key Series

Nuvoton Touch Key Series
NT084D
Datasheet

For additional information or questions, please contact: Nuvoton Technology Corporation.

www.nuvoton.com

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1 GENERAL DESCRIPTION

The Nuvoton touch key series, NT084D, provides easy-to-implement capacitive touch key user interface solutions. It supports configurable 8 touch key interfaces, and four 7-segment LED output for easy debugging development environment and provides more display elements. The NT084D supports many functions, such as speed key response, multi-key response and configuration, key lock function and other modes which can achieve the shortest development cycle of capacitive touch key applications. Meanwhile, an external host MCU can control the NT084D through the I²C bus easily.

The use of the NT084D evaluation board does not require additional design from beginning to end. The NT084D has excellent anti-impulse noise and anti-electromagnetic noise ability, as well as excellent resistance to electromagnetic interference, electromagnetic waves of mobile phones and walky-talky electromagnetic immunity. It also features water repellent or water-droplet operation without error, automatic key lock function, and corresponding to the environmental surfaces moisture. The NT084D has a comprehensive response to a variety of applications.

The NT084D is suitable for a wide range of applications such as audio panel, telephone keyboard control, instrument control panel, washing machine control panel, intelligent access control panel system, various small appliances (cooker, disinfection cabinet, microwave oven, etc.), household appliances, handheld devices, industrial control, automotive electronics, and any others related to the control panel button applications.

2 FEATURES

- Support 8 capacitive touch keys and 8 corresponding output channels with four 7-segment LED output selection
- Multiple touch key output selection
  - Single touch key / multi-keys function selectable
  - Key lock function
  - Low active/high active output
  - Toggle function
  - Slider options
- Output modes
  - LED output (push-pull mode)
  - GPIO（open-drain）sweeping can be configured to output
  - I²C
- I²C parameter settings
  - Touch key trigger level for each key
  - Touch key de-bounce for each key
  - Auto calibration interval
- Water repellent or water-droplet operation
  - Water-droplet operation without error
  - Water key response
  - Key lock function
- ESD / EFT
- Resist electromagnetic immunity
  - Resistance to electromagnetic waves of mobile phones
  - Resist 5W walky-talky electromagnetic immunity (> 2 cm)
- Operating voltage: 2.4 V ~ 5.5 V
- Operating current: 1.8 mA ~ 2.3 mA
- Operating temperature: -40 ℃ ~ 85 ℃
- Touch key response time: 81 ms

- Comprehensive feature and package

Part number	Number of keys	Output	Slider function	Wheel function	LED control	Package
NT1160AT20	16 keys	I²C	-	-	3	TSSOP20
NT1080AT20	8 keys	I²C	-	-	5	TSSOP20
NT084DAT28	8 keys	I²C	Yes	Yes	4*8	TSSOP28
NT066EAT20	6 keys	I²C	Yes	Yes	6	TSSOP20
NT0880AT20	8 keys	8 corresponding output channels	-	-	-	TSSOP20
NT0660AS16	6 keys	6 corresponding output channels	-	-	-	SOP16

3 PIN DIAGRAM

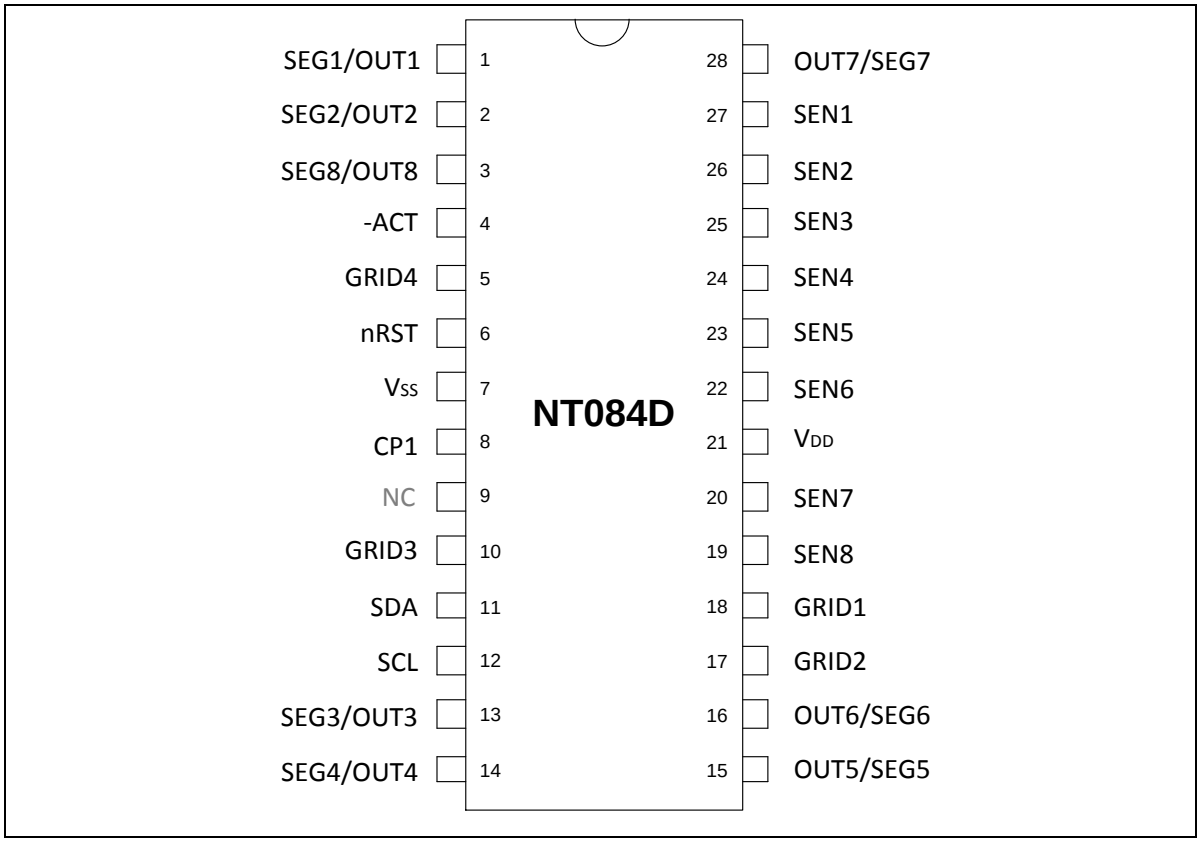


Figure 3-1 TSSOP28 Pin Diagram

No.	Pin Name	Description
1	SEG1/OUT1	7-segment LED display (a segment) / touch key-1 output pin
2	SEG2/OUT2	7-segment LED display (b segment) / touch key-2 output pin
3	SEG8/OUT8	7-segment LED display (dp segment) / touch key-8 output pin
4	-ACT	Touch key operation instruction
5	GRID4	7-segment LED display common 4
6	nRST	IC reset pin
7	V_{SS}	Ground pin
8	CP1	Touch key driving signal
9	NC	Unused
10	GRID3	7-segment LED display common 3
11	SDA	I²C data pin
12	SCL	I²C clock pin

13	SEG3/OUT3	7-segment LED display (c segment) / touch key-3 output pin
14	SEG4/OUT4	7-segment LED display (d segment) / touch key-4 output pin
15	SEG5/OUT5	7-segment LED display (e segment) / touch key-5 output pin
16	SEG6/OUT6	7-segment LED display (f segment) / touch key-6 output pin
17	GRID2	7-segment LED display common 2
18	GRID1	7-segment LED display common 1
19	SEN8	Touch key-8
20	SEN7	Touch key-7
21	V_{DD}	Power supply pin
22	SEN6	Touch key-6
23	SEN5	Touch key-5
24	SEN4	Touch key-4
25	SEN3	Touch key-3
26	SEN2	Touch key-2
27	SEN1	Touch key-1
28	SEG7/OUT7	7-segment LED display (g segment) / touch key-7 output pin

Table 3-1 Pin Description

4 CAPACITIVE TOUCH KEY

4.1 Input Circuit

Each capacitive touch key needs to be connected with a resistor in series as shown in Figure 4-1. Different system board design no need to change this resistor value. At the same time, all the resistors need to be kept as close as possible to sensor pad during PCB layout.

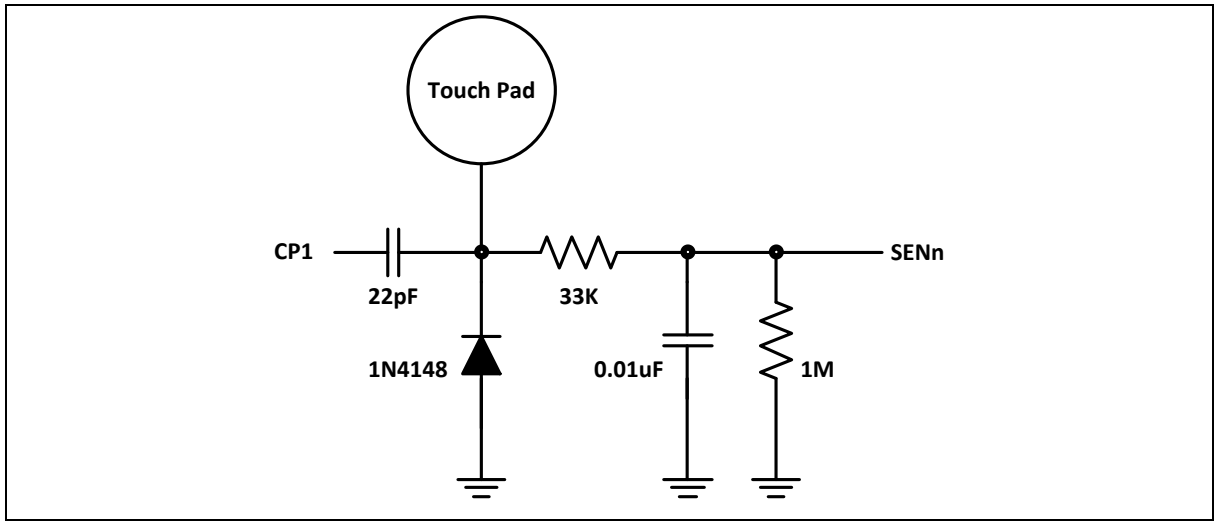


Figure 4-1 Touch Key Reference Circuit

4.2 Sensor Pad and Ground for PCB Layout

The size of sensor pad, using circular shape with diameter equal or greater than 8mm is recommended. Actually, sensor pad could be any kinds of shape, but fulfilling finger size is suitable. **Extra ground-net around sensor pads is not needed for PCB design,** however, ground-net along sensor pad to chip is alternative. Figure 4-2 Sensor Pad and Ground-Net shows that the PCB line width of sensor pad to chip should be 0.254mm (10mil) or less and to keep distance with ground at least 1mm. The other layer of PCB could implement ground-net for PCB artwork to block noise interfering with signal line. All the subsidiary components need to be kept as close to sensor pad as possible at PCB layout. Meanwhile, the touch key chip (NT084D) and touch pad located on the same PCB board would be better.

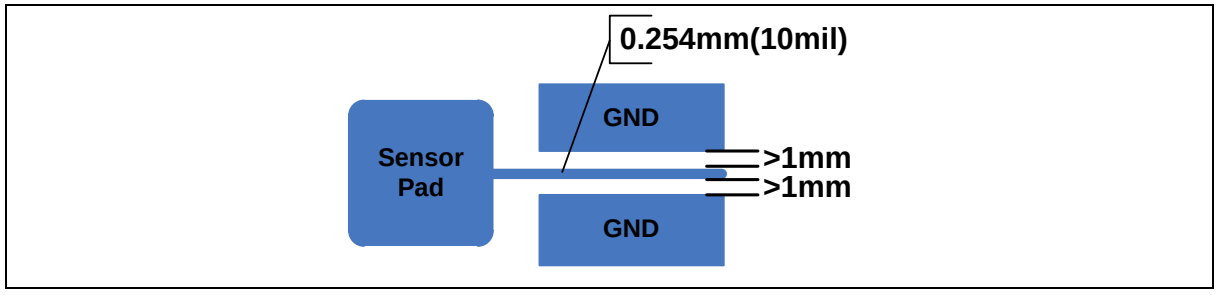


Figure 4-2 Sensor Pad and Ground-Net

As shown in Figure 4−3, a spring attached to the metal-panel can be used to act as a sensor pad. It is recommended that the metal-panel (ring) should be adhered to the inside of cover to be an effective sensing area. If user wants to add an LED in the middle of sensor pad, the measure of sensor area should be increased to compensate the hollowing part and keeping the same sensitivity.

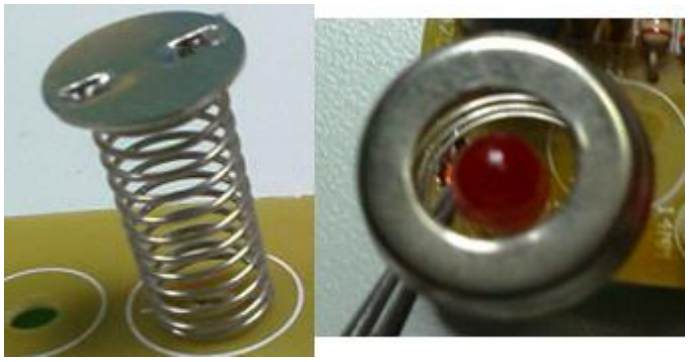


Figure 4-3 Spring with Solid Metal Plane/Ring

4.3 Sensor Pad Size

The size of sensor pad plays a significant role in determining the thickness of panel. The greater area of sensor pad is, the deeper touch signal could be detected. Table 4−1 shows the relationship between the pad size and panel thickness.

Size of Sensor Pad	Panel Thickness (Recommended Value)
10mm x 10mm	2.0mm
15mm x 15mm	3.0mm
20mm x 20mm	4.0mm
25mm x 25mm	6.0mm

Table 4-1 Sensor Pad and Corresponding Panel Thickness

5 I²C INTERFACE

The maximum speed of I²C serial interface could be up to 400Kbps and it will not send any signal in an active way to main controller since it is I²C slave. User could easily set the touch related parameter and adjust the sensitivity by using the I²C interface.

The I²C transmission provides three modes: byte-write, random-read and continuous-read.

5.1 Byte-Write

The data protocol includes 3 bytes from master writing data to slave. The first byte for Device address, the second byte for Memory address and the third byte is for the write data. Figure 5−1 shows the detail about byte-write action.

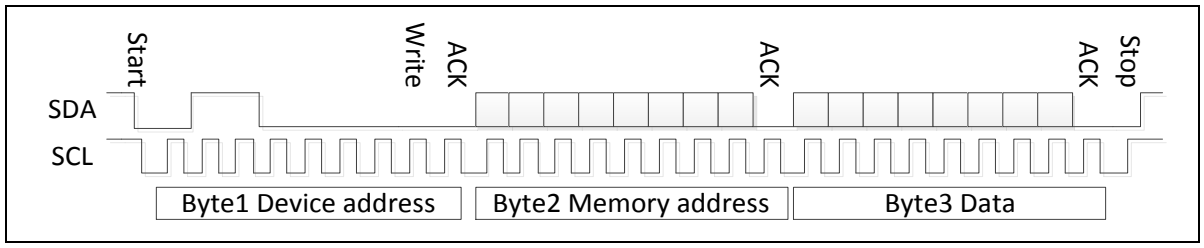


Figure 5-1 Byte-write Mode

The SDA and SCL are kept as logic 1. For the start signal, SDA will change to logic 0 first then SCL to logic 0 as well. When transmitting, data is prepared on SDA signal and then SCL will change to logic 1. Slave reads the byte data based on the rising edge of SCL signal. Slave will send logic 0 on the 9th clock signal to indicate receiving the byte data. For the stop signal, master device will change SCL to logic 1 and then SDA to 1, when the transmission of 3 bytes of information is finished.

5.2 Random-Read

This is a 4-byte data combination when Master reads Slave. Figure 5−2 shows that the first byte is used as device address and write-status; the second byte is used as memory address; the third byte is used as device address and read-status and the fourth byte is used as Slave output data with Master keeping sending the SCL clock signal.

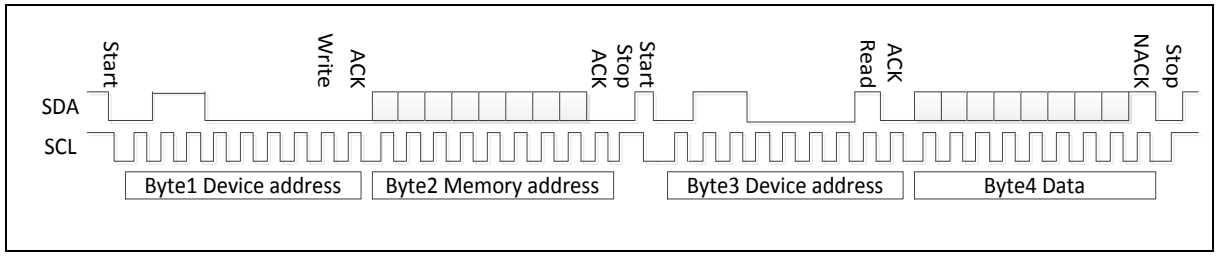


Figure 5-2 Random-Read Mode

After finishing the 2nd byte data transmission, the start signal is needed before sending the next 3rd byte data. The SCL signal will change to logic 0 when 3rd byte data transmission is done. SCL signal will be released till 4th output data is ready. The first host could send logic 1 on SCL and monitor SCL changing to logic 1 to receive 1st bit, or at least wait 60uS before sending the first SCL clock signal. Note that Master should send a logic 1, NACK signal, on the 9th clock signal of the 4th byte.

5.3 Continuous-Read

This is a 4-byte data combination when Master continually reads Slave. Figure 5-3 shows that the first byte as device address and write-status; the second byte as memory address; the third byte as device address and read-status. From the fourth byte, Slave will keep output data with Master keeping sending ACK and SCL clock signal. The memory address will be automatically increased.

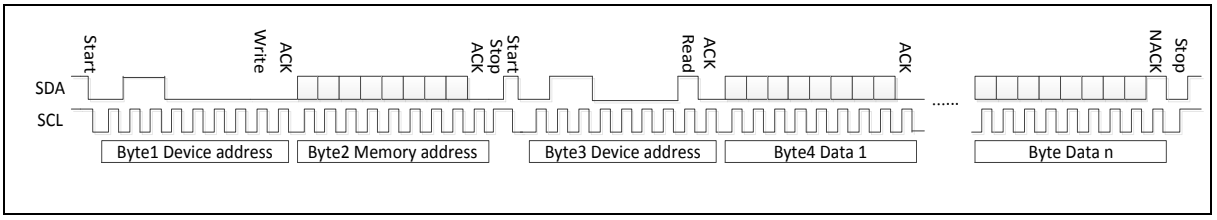


Figure 5-3 Continuous-Read Mode

5.4 I²C Circuit

The I²C pins are SDA and SCL with Open-Drain mode which **requires pull-high resistor on the I²C bus,** as shown in Figure 5-4.

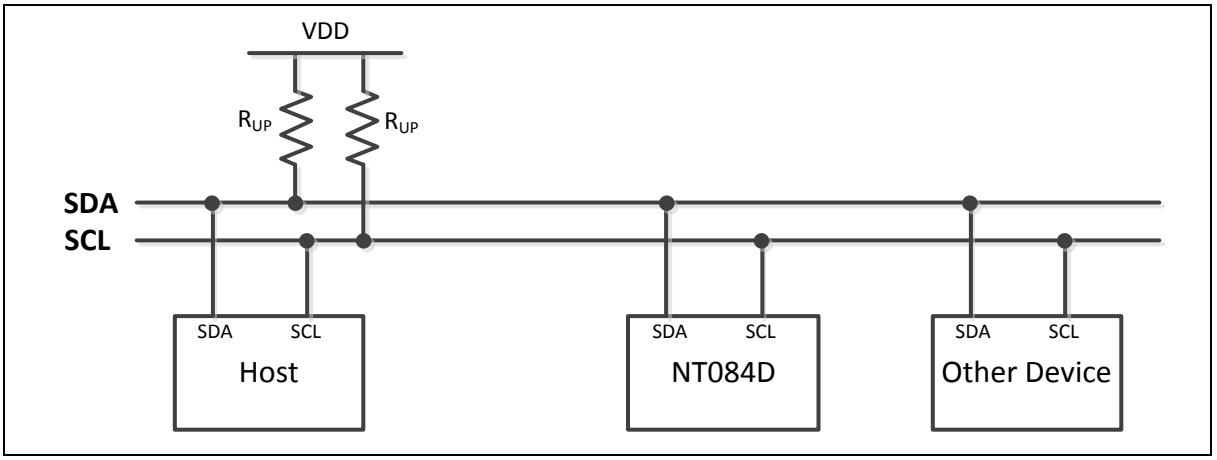


Figure 5-4 I²C Bus Connection

6 I²C DATA DEFINITION

6.1 Memory Address

Table 6−1 shows the memory address of I²C starting from 0x00~0x4F with specific function on each address.

R: Read only, **R/W:** Read / Write,

(B)R: Must be set "Build" bit, and user can read only, **(B)R/W:** Must be set to "Build" bit, and user can read and write.

<table>
<tr><th>Address</th><th>R/W</th><th>Description</th><th>Default</th></tr>
<tr><td>0x00</td><td>R</td><td>Product no.</td><td>0x4D</td></tr>
<tr><td>0x01</td><td>R</td><td>Shows how many buttons supported.</td><td>0x08</td></tr>
<tr><td>0x02</td><td>R</td><td>Version no.</td><td>0x21</td></tr>
<tr><td>0x03</td><td>R/W</td><td>I²C Device address
<table><tr><th>Bit7</th><th>Bit6</th><th>Bit5</th><th>Bit4</th><th>Bit3</th><th>Bit2</th><th>Bit1</th><th>Bit0</th></tr><tr><td>A7</td><td>A6</td><td>A5</td><td>A4</td><td>A3</td><td>A2</td><td>A1</td><td>0</td></tr></table></td><td>0x60</td></tr>
<tr><td>0x04</td><td>R/W</td><td>System control
<table><tr><th>Bit7</th><th>Bit6</th><th>Bit5</th><th>Bit4</th><th>Bit3</th><th>Bit2</th><th>Bit1</th><th>Bit0</th></tr><tr><td>Reset</td><td>-</td><td>-</td><td>-</td><td>Auto</td><td>Calibrate</td><td>-</td><td>Build</td></tr></table></td><td>0x08</td></tr>
<tr><td>0x05</td><td>R/W</td><td>Sweeping
<table><tr><th>Bit7</th><th>Bit6</th><th>Bit5</th><th>Bit4</th><th>Bit3</th><th>Bit2</th><th>Bit1</th><th>Bit0</th></tr><tr><td>En-Sweeping</td><td>M1</td><td>M0</td><td>T4</td><td>T3</td><td>T2</td><td>1</td><td>1</td></tr></table></td><td>0x03</td></tr>
<tr><td>0x06</td><td>R/W</td><td>Output mode
<table><tr><th>Bit7</th><th>Bit6</th><th>Bit5</th><th>Bit4</th><th>Bit3</th><th>Bit2</th><th>Bit1</th><th>Bit0</th></tr><tr><td>Multi</td><td>Toggle</td><td>Act-High</td><td>Display</td><td>Lock</td><td>En-Any</td><td>0</td><td>Dout_0</td></tr></table></td><td>0x00</td></tr>
<tr><td>0x07</td><td>(B)R/W</td><td>Sense pin enable
<table><tr><th>Bit7</th><th>Bit6</th><th>Bit5</th><th>Bit4</th><th>Bit3</th><th>Bit2</th><th>Bit1</th><th>Bit0</th></tr><tr><td>Sen8</td><td>Sen7</td><td>Sen6</td><td>Sen5</td><td>Sen4</td><td>Sen3</td><td>Sen2</td><td>Sen1</td></tr></table></td><td>0xFF</td></tr>
<tr><td>0x0C</td><td>(B)R/W</td><td>De-Bounce (Range: 1~7)</td><td>0x03</td></tr>
<tr><td>0x0D</td><td>(B)R/W</td><td>Plus Times (Range: 15~127)</td><td>0x32</td></tr>
<tr><td>0x0E</td><td>(B)R/W</td><td>Sensor Cycle (Range: 3~15)</td><td>0x07</td></tr>
<tr><td>0x0F</td><td>(B)R/W</td><td>Calibration Delay (Range: 7~63)</td><td>0x32</td></tr>
<tr><td>0x10</td><td>R</td><td>Status
<table><tr><th>Bit7</th><th>Bit6</th><th>Bit5</th><th>Bit4</th><th>Bit3</th><th>Bit2</th><th>Bit1</th><th>Bit0</th></tr><tr><td>Any-Act</td><td>B-Change</td><td>S-Change</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr></table></td><td>0x00</td></tr>
</table>

<table>
<tr><td>0x11</td><td>R</td><td>Key Status<table><tr><th>Bit7</th><th>Bit6</th><th>Bit5</th><th>Bit4</th><th>Bit3</th><th>Bit2</th><th>Bit1</th><th>Bit0</th></tr><tr><td>Sen8</td><td>Sen7</td><td>Sen6</td><td>Sen5</td><td>Sen4</td><td>Sen3</td><td>Sen2</td><td>Sen1</td></tr></table></td><td>0x00</td></tr>
<tr><td>0x14</td><td>R</td><td>Slider Status<table><tr><th>Bit7</th><th>Bit6</th><th>Bit5</th><th>Bit4</th><th>Bit3</th><th>Bit2</th><th>Bit1</th><th>Bit0</th></tr><tr><td colspan="8">-128~127 Value</td></tr></table></td><td>0x00</td></tr>
<tr><td>0x15</td><td>R/W</td><td>7-segment LED Output 1<table><tr><th>Bit7</th><th>Bit6</th><th>Bit5</th><th>Bit4</th><th>Bit3</th><th>Bit2</th><th>Bit1</th><th>Bit0</th></tr><tr><td>Seg8</td><td>Seg7</td><td>Seg6</td><td>Seg5</td><td>Seg4</td><td>Seg3</td><td>Seg2</td><td>Seg1</td></tr></table></td><td>0x00</td></tr>
<tr><td>0x16</td><td>R/W</td><td>7-segment LED Output 2<table><tr><th>Bit7</th><th>Bit6</th><th>Bit5</th><th>Bit4</th><th>Bit3</th><th>Bit2</th><th>Bit1</th><th>Bit0</th></tr><tr><td>Seg8</td><td>Seg7</td><td>Seg6</td><td>Seg5</td><td>Seg4</td><td>Seg3</td><td>Seg2</td><td>Seg1</td></tr></table></td><td>0x00</td></tr>
<tr><td>0x17</td><td>R/W</td><td>7-segment LED Output 3<table><tr><th>Bit7</th><th>Bit6</th><th>Bit5</th><th>Bit4</th><th>Bit3</th><th>Bit2</th><th>Bit1</th><th>Bit0</th></tr><tr><td>Seg8</td><td>Seg7</td><td>Seg6</td><td>Seg5</td><td>Seg4</td><td>Seg3</td><td>Seg2</td><td>Seg1</td></tr></table></td><td>0x00</td></tr>
<tr><td>0x18</td><td>R/W</td><td>7-segment LED Output 4<table><tr><th>Bit7</th><th>Bit6</th><th>Bit5</th><th>Bit4</th><th>Bit3</th><th>Bit2</th><th>Bit1</th><th>Bit0</th></tr><tr><td>Seg8</td><td>Seg7</td><td>Seg6</td><td>Seg5</td><td>Seg4</td><td>Seg3</td><td>Seg2</td><td>Seg1</td></tr></table></td><td>0x00</td></tr>
<tr><td>0x20
~
0x27</td><td>(B)R/W</td><td>Trigger Level (Range: 3~63)<table><tr><th>0x20</th><th>0x21</th><th>0x22</th><th>0x23</th><th>0x24</th><th>0x25</th><th>0x26</th><th>0x27</th></tr><tr><td>Sen1</td><td>Sen2</td><td>Sen3</td><td>Sen4</td><td>Sen5</td><td>Sen6</td><td>Sen7</td><td>Sen8</td></tr></table></td><td>0x12</td></tr>
<tr><td>0x40
~
0x4F</td><td>(B)R</td><td>Sensor Value<table><tr><th>0x40</th><th>0x41</th><th>0x42</th><th>0x43</th><th>0x44</th><th>0x45</th><th>0x46</th><th>0x47</th></tr><tr><td>Sen1-H</td><td>Sen1-L</td><td>Sen2-H</td><td>Sen2-L</td><td>Sen3-H</td><td>Sen3-L</td><td>Sen4-H</td><td>Sen4-L</td></tr><tr><th>0x48</th><th>0x49</th><th>0x4A</th><th>0x4B</th><th>0x4C</th><th>0x4D</th><th>0x4E</th><th>0x4F</th></tr><tr><td>Sen5-H</td><td>Sen5-L</td><td>Sen6-H</td><td>Sen6-L</td><td>Sen7-H</td><td>Sen7-L</td><td>Sen8-H</td><td>Sen8-L</td></tr></table></td><td>0x0000</td></tr>
</table>

Table 6-1 I^{2}C Memory Address Definition and Description

6.2 Address 0x00: Product No.

For product identification use.

6.3 Address 0x01: Button No.

For product identification use.

6.4 Address 0x02: Version No.

For product identification use.

6.5 Address 0x03: I²C Device Address

The default address is 0x60, including read/write 8-bit address. The device address could be changed by the I²C interface. When changing the device address, the latest device address must be used in the next read/write action. .

6.6 Address 0x04: System Control Bits

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Reset	-	-	-	Auto	Calibrate	-	Build

Reset: **Software reset**
Chip could be reset by writing “1” to become default value. This bit will be automatically changed back to “0” when chip reset is done.

Auto: **Auto calibration.**
Write “1” to this bit and chip will automatically refer the value in address “0x0F” to execute new calibration delay time function.

Calibrate: **Calibration enabled.**
User could set this bit to enable calibration procedure and this bit will return to “0” when finishing the calibration. This bit is valid when “Auto” bit is “0”.

Build: **Test mode.**
1 = Read related sensor parameter and data to provide test and analysis function.
0 = Hide some parameter which has nothing to do with operation action to prevent parameter being changed accidentally.

6.7 Address 0x05: Sweeping settings

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
En-Sweeping	M1	M0	T4	T3	T2	1	1

En-Sweeping： Sweeping function can only be enabled if the display bit is set to 1.
1 = Enable sweeping.
0 = Disable sweeping.

M1~M0： Sweeping mode setting, as shown in table 6-2.

M1	M0	Description

0	0	Composed by 5 output pins, from OUT1 sequentially lit LED to OUT8, then back to OUT1 in one-way loop.
0	1	Composed by 5 output pins, from OUT8 sequentially lit LED to OUT1, then back to OUT8 in one-way loop.
1	0	Composed by 3 output pins, from OUT1 sequentially lit to OUT8, then from OUT8 back to OUT1 in bidirectional loop.
1	1	Composed by 1 output pin, from OUT1 sequentially lit to OUT8, then from OUT8 back to OUT1 in bidirectional loop.

Table 6-1 Sweeping mode

T4~T2： Time interval, range：32～3, each step is 10ms, therefore the time interval is set up to 0.32s.

6.8 Address 0x06: Output Mode Settings

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Multi	Toggle	Act-High	Display	Lock	En-Any	0	Dout_0

Multi: **Multi-key output**
1 = Output multi-key status simultaneously.
0 = Output the key status with greatest signal.

Toggle: **Switch Mode**
1 = GPIO is set to output signal in latch way to simulate like a switch. Press to active and then press to inactive.
This bit is active when “Display” is set as “0” and “Dout_0” as “1”. The high/low level will be decided by the “Act-High” setting.

Act-High: **High level action**
1 = GPIO output high level.
0 = GPIO output low level.
This bit is active when “Display” is set as “0” and “Dout_0” as “1”.

Display： **LED Display**
1 = Enable LED Display. You can fill in different values in memory address 0x15 ~ 0x18 to turn on the corresponding LED.
0 = Disable LED display.

Lock: **Lock**
1 = If two or more keys are triggered, all output will be locked and no any output signal happened.
0 = Disable Lock function.

En-Any: **Enable -Act pin**
1 = Enable -Act pin function. Any pressed key will make -Act pin output low level signal. -Act pin will return to high level when no key is pressed.

0 = Disable -Act pin function.

Dout_0： **GPIO Output Mode**

1 = Enable each output corresponding to each key.（7-segment LED is lit for 1 segment）

0 = The 7-segment LED show corresponding to each key number.

6.9 Address 0x07: Enable Sense Pin

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Sen8	Sen7	Sen6	Sen5	Sen4	Sen3	Sen2	Sen1

Sen8~Sen1: **Enable Sense Pin.**
1 = Enable corresponding key
0 = Disable corresponding key

6.10 Address 0x0A: Slider Setting

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Slide	0	0	0	0	0	Sen8-5	Sen4-1

Slide： **Slider enable bit**
1 = Enable slider function
0 = Disable slider function

Sen8-5： **Slider Key 8 ~ 5**
1 = Enable Key 8 ~ Key 5 as the sense key sliders.

0 = Disable Key 8 ~ Key 5 as the sense key sliders.

Sen4-1： **Slider Key 4 ~ 1**
1 = Enable Key 4 ~ Key 1 as the sense key sliders.

0 = Disable Key 4 ~ Key 1 as the sense key sliders.

6.11 Address 0x0C: De-Bounce

The value ranges from 1 to 7. Set this parameter to avoid key output bouncing. The key will react slower with less chance of bouncing if this value is set higher.

6.12 Address 0x0D: Plus Times

The value ranges from 15 to 127. The captures data will be more stable and key react slower if this value is set higher.

6.13 Address 0x0E: Sensor Cycle

The value ranges from 3 to 15. The captures data will be more stable and key react slower if this value is set higher.

6.14 Address 0x0F: Calibration Delay

The value ranges from 7 to 63. It defines how long the chip will do re-calibration process again.

This bit is valid if “Auto” bit is set to “1”.

6.15 Address 0x10: Status.

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Any-Act	B-Change	S-Change	0	0	0	0	0

Any-Act: This bit will be set to “1” if any key is pressed.
It will be cleared to “0” if all key are released.

B-Change: This bit will be set to “1” if any key status is changed.
It will be cleared to “0” if no key status is changed whether key is pressed or not.

S-Change: This bit will be set to “1” if any slider status is changed. The slider status continues to accumulate. It will be cleared to “0” if no slider status is changed and read through I²C.

6.16 Address 0x11: Key Status

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Sen8	Sen7	Sen6	Sen5	Sen4	Sen3	Sen2	Sen1

Sen8~Sen1: 1 = Corresponding key is pressed.
0 = Corresponding key is released.
Reading status here will ignore the setting in Output mode.

6.17 Address 0x14: Slider Status

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
-128~127 Value							

Slide direction and scale setting

If the value is positive, indicating the slide direction is slid from key 1 to key 4. While a negative value indicates the slide direction is slid from key 4 to key 1. When the slider is set to other keys in the same direction, and if there is no time to read, scale value will automatically accumulate, until after the reading will be cleared to 0x00.Recommended interval time to read is relatively large, since interval time is a scale value relative to the evaluation board, therefore the slider can be made into strip or ring.

6.18 Address 0x15～0x18: 7-Segment LED Display

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Seg8	Seg7	Seg6	Seg5	Seg4	Seg3	Seg2	Seg1

0x15 corresponding to GRID1, 0x16 corresponding to GRID2, 0x17 corresponding to GRID3, 0x18 corresponding to GRID4 common pin. Seg1～Seg8 corresponding to

SEG1～SEG8 pin.

If user enable sweeping (Memory address 0x05), GRID1 will be connected to multiple single LEDs, memory address 0x15. Sweeping function will automatically fill in data. Although it can read / write, but it will affect the sweeping display.

7-segment LED display is set as follows.

Seg8： 7-segment LED, dp segment, set 1 to turn on LED.
Seg7： 7-segment LED, g segment, set 1 to turn on LED.
Seg6： 7-segment LED, f segment, set 1 to turn on LED.
Seg5： 7-segment LED, e segment, set 1 to turn on LED.
Seg4： 7-segment LED, d segment, set 1 to turn on LED.
Seg3： 7-segment LED, c segment, set 1 to turn on LED.
Seg2： 7-segment LED, b segment, set 1 to turn on LED.
Seg1： 7-segment LED, a segment, set 1 to turn on LED.

6.19 Address 0x20~0x27: Trigger Level

The value is from 3 to 63. This bit is to set trigger level individually to eliminate the sensitivity difference on each touch key sensor. The lower value user set will get higher sensitivity but lower stability.

Address	**0x20**	**0x21**	**0x22**	**0x23**	**0x24**	**0x25**	**0x26**	**0x27**
Sensor	Sen1	Sen2	Sen3	Sen4	Sen5	Sen6	Sen7	Sen8

6.20 Address 0x40~0x4F: Sensor Value

Address	**0x40**	**0x41**	**0x42**	**0x43**	**0x44**	**0x45**	**0x46**	**0x47**
Sensor	Sen1-High	Sen1-Low	Sen2-High	Sen2-Low	Sen3-High	Sen3-Low	Sen4-High	Sen4-Low
Address	**0x48**	**0x49**	**0x4A**	**0x4B**	**0x4C**	**0x4D**	**0x4E**	**0x4F**
Sensor	Sen5-High	Sen5-Low	Sen6-High	Sen6-Low	Sen7-High	Sen7-Low	Sen8-High	Sen8-Low

The value shows the reading sampling result which is from 0 to 1023. The data format is MSB first, then LSB.

7 GPIO

Each GPIO has the corresponding touch key output. For example, the OUTn pin corresponds to the SENn pin. There are many kinds of output modes related to address 0x06 settings. Table 7-1 shows each bit settings.

Application	Multi	Toggle	Act-High	Display	Lock
Single key, active low	0	0	0	0	0
Single key, active high	0	0	1	0	0
Multi keys, active low	1	0	0	0	0
Multi keys, active high	1	0	1	0	0
Single key, switch, active low	0	1	0	0	0
Single key, switch, active high	0	1	1	0	0
Multi keys, switch, active low	1	1	0	0	0
Multi keys, switch, active high	1	1	1	0	0
Single key, active low, lock	0	0	0	0	1
Single key, active high, lock	0	0	1	0	1
Single key, switch, active low, lock	0	1	0	0	1
Single key, switch, active high, lock	0	1	1	0	1

Table 7-1 GPIO Function Settings

8 7-SEGMENT LED DISPLAY

After LED display is enabled, the key status must be obtained from the memory address 0x11. As long as the key is pressed, the corresponding bit is set to 1. If not, the corresponding bit is cleared to 0. The LED display option not only can drive 7-segment display, but also drive multiple single LEDs of the corresponding bit to lit, as long as the I^2C memory address 0x15 ~ 0x18 is entered. Table 8-1 shows the related settings.

X – Don't care.

Application	Multi	Toggle	Act -High	Display	Lock	Dout_0	En-Sweep
Display key number	X	X	X	0	X	0	0
I^2C control display (4*7-segment)	X	X	X	1	X	X	0
I^2C control display (3*7-segment+ sweeping)	X	X	X	1	X	X	1

Table 8-1 LED Display Settings

9 REFERENCE SCHEMATIC

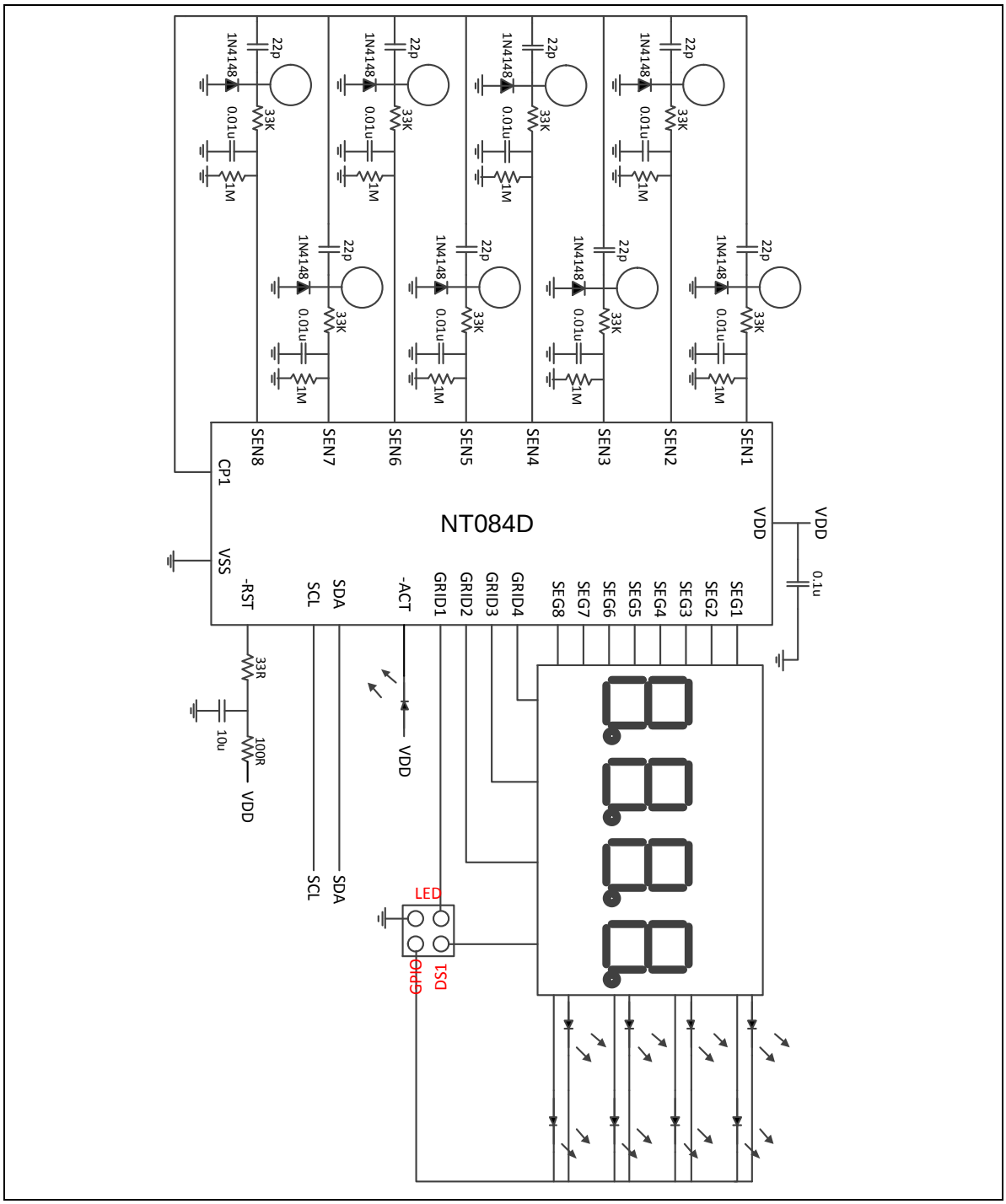


Fig 9-1 Reference Circuit

10 ELECTRICAL CHARACTERISTICS

10.1 Absolute Maximum Ratings

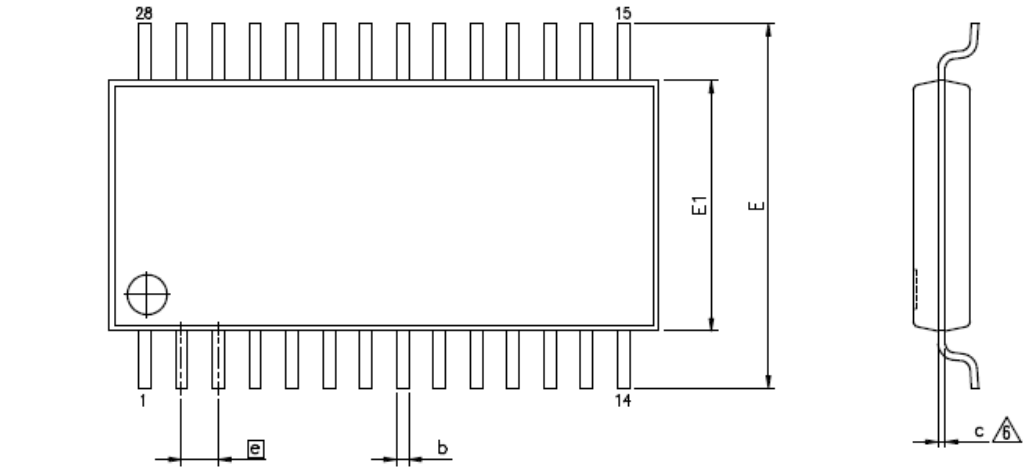
Parameter	Range	Unit
Operating Temperature	-40 to +85	°C
Storage Temperature	-55 to +150	°C
V_{DD} to V_{SS} voltage	-0.3 to +6.5	V
Other pin to V_{SS} voltage	-0.3 to (V_{DD}+0.3)	V

10.2 DC Electrical Characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Voltage	**V_{DD}**	---	2.4	-	5.5	V
Operating Current	**I_{DD}**	V_{DD} = 5V	-	2.30	-	mA
		V_{DD} = 3V	-	1.93	-	mA
Input Low Voltage	**V_{IL}**	2.4V<V_{DD}<5.5	-0.5	-	0.3V_{DD}	V
Input High Voltage	**V_{IH}**	2.4V<V_{DD}<5.5	0.7V_{DD}	-	V_{DD}+0.5	V
Output Low Voltage (GPIO)	**V_{OL1}**	V_{DD} = 4.5V, I_{OL} = 20mA	-	-	0.45	V

11 PACKAGE DIMENSION

11.1 28 Pin TSSOP – 4.4X9.7mm



VARIATIONS (ALL DIMENSIONS SHOWN IN MM)

SYMBOLS	MIN.	NOM.	MAX.
A	–	–	1.20
A1	0.00	–	0.15
A2	0.80	1.00	1.05
b	0.19	–	0.30
c	0.09	–	0.20
D	9.60	9.70	9.80
E1	4.30	4.40	4.50
E		6.40 BSC	
e		0.65 BSC	
L1		1.00 REF	
L	0.45	0.60	0.75
S	0.20	–	–
θ	0°	–	8°
Y		0.10	

12 REVISION HISTORY

Date	Revision	Description
2016.11.10	1.00	Initial version

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