

Table of Contents

1. Product Overview	2
2. Key Features.....	2
3. Package and Pin Description	2
4. Functional Description	4
5. Register Description	5
6. I ² C Communication Protocol	11
6.1 Protocol Overview	11
6.2 Slave Address	11
6.3 Write Operation	11
6.4 Read Operation	11
7. Application Circuit	12
8. Application Notes	13
9. Host Software Flowchart	14
10. Touch PCB Layout Guidelines	15
11. Electrical Specifications.....	16
11.1 Absolute Maximum Ratings	16
11.2 DC Characteristics	16
12. Package Dimensions	17
12.1 SOP16 Package	17
12.2 QFN16 Package	18
13. Revision History	19

10-Channel Touch I²C Output IC

Document No.: PTDS26002

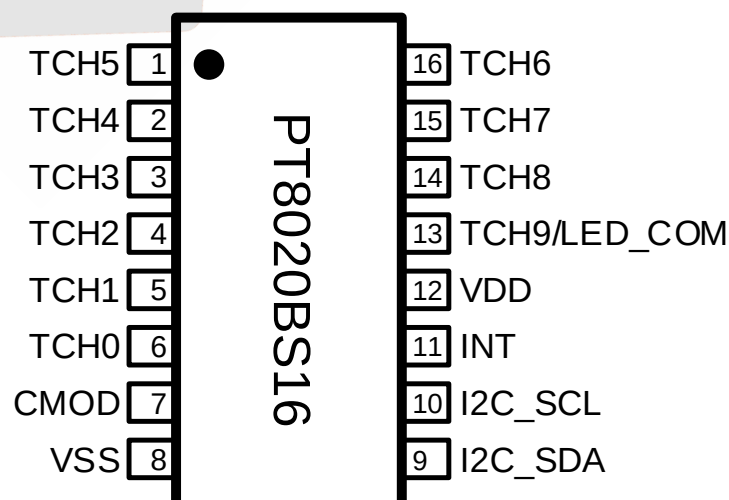
1. Product Overview

PT8020B is a capacitive touch control ASIC featuring 10-channel touch input and I²C key code output. Sensitivity and functional parameters are configurable via the I²C interface. Its built-in algorithm supports trace self-compensation, delivering high anti-interference performance and wide operating voltage range. It is ideally suited for control panels of small home appliances, remote controllers and other consumer electronics.

2. Key Features

- Operating voltage range: 2.4~5.5V
- Operating current: 1.5mA (normal mode); 7uA (low-power mode) @V_{DD}=3V&CMOD=10nF
- 10-channel touch input with I²C key code output
- 9 touch pins multiplexed with LED function, supporting synchronous touch indication or programmable LED control
- Unused touch channels configurable as GPIO outputs
- Adaptive mode with self-compensation for channel mismatch and trace length variation
- Global sensitivity adjustment via external capacitor on CMOD pin; higher capacitance = higher sensitivity
- All touch parameters independently adjustable via I²C interface
- Built-in voltage regulator, power-on reset (POR) and brown-out reset (BOR)
- Integrated real-time environmental adaptation and high-efficiency digital filtering algorithms
- HBM ESD rating: > 4kV
- Available packages: SOP16、QFN16

3. Package and Pin Description



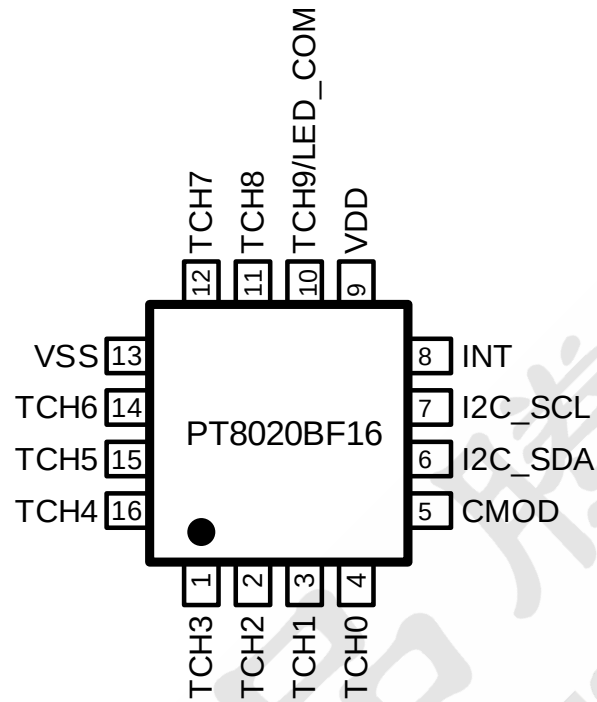


Figure1 Pin Diagram

Table1 Pin Description

NO.	Pin Name	I/O	Description
1	TCHx	I	Touch input pins
2	CMOD	I	Sampling capacitor input pin
3	VSS	P	Ground (negative supply)
4	VDD	P	Positive power supply
5	LED_COM	O	ED common terminal
6	INT	O	Interrupt output; outputs 10ms low pulse on key change or chip reset
7	I2C_SDA	I/O	I ² C data line
8	I2C_SCL	I/O	I ² C clock line

I => CMOS input only I/O => CMOS bidirectional

O => CMOS output P => Power / ground

4. Functional Description

- Default Configuration:
 - Channel enable: 10 channels enabled
 - Threshold mode: Adaptive
 - Low-power mode: Enabled
 - Long-key reset: All enabled channels reset after 16s of continuous touch
 - Sleep idle time: 4s with no touch event
 - Key code read addresses: 0x23 (TCH9 ~ TCH8), 0x22 (TCH7 ~ TCH0)
 - All touch parameters configurable via I²C interface
 - Maximum I²C communication speed: 100K/s
 - Debug output mode for sensitivity tuning and fault analysis; INT and I²C are non-responsive in debug mode
 - Touch pin multiplexed LED drive: parasitic capacitance of LEDs reduces touch sensitivity.
- Reference configuration:

Channels	Touch Pad	Threshold Mode	Adaptive Threshold	CMOD Cap.	Dielectric Thickness	LED
9	10*10mm	Adaptive	150	10nF	2mm	0805 Blue LED

- Pin Function Details
 - LED_COM: Common drive terminal for multiplexed LEDs
 - INT:
 - High at idle; outputs a 10ms low pulse on key state change or chip reset

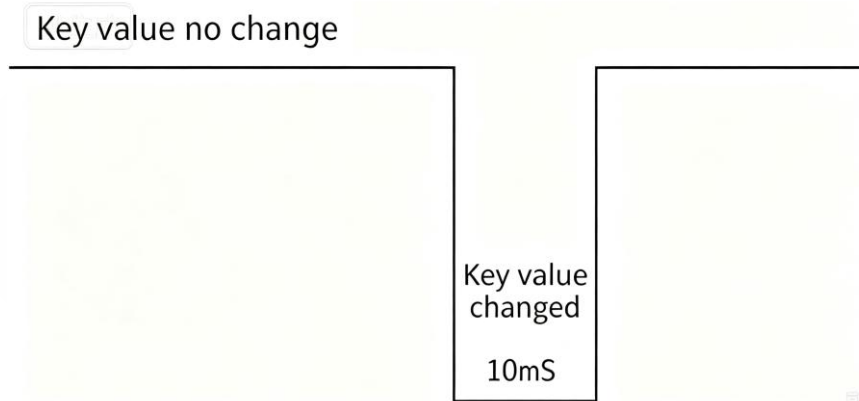


Figure2 INT Output Timing Diagram

- Debug entry: Pull INT low for 5s during normal operation to enter debug mode (INT and I²C inactive). Debug data is output via INT pin.
- Debug output: UART format, baud rate 38400 bps

5. Register Description

Table2 Register Summary

Addr.	Symbol	Description	Bit Description								Default	Range
			Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0		
01h	CTRL1	Control Register 1	MOD	LKEN	MKEN	LEDEN	LEDM	SLPEN	SRST	SETEN	1100 0100	-
02h	CTRL2	Control Register 2	-	-	-	CLK2T	LEDCM[1:0]		SLPIN	LDOEN	0000 0000	-
03h	THEN1	Touch Enable	CH7EN	CH6EN	CH5EN	CH4EN	CH3EN	CH2EN	CH1EN	CH0EN	1111 1111	-
04h	THEN2								CH9EN	CH8EN	0000 0011	-
06h	THS0	Manual Threshold	THS0[7:0]								0100 0000	20~250
07h	THS1		THS1[7:0]									
08h	THS2		THS2[7:0]									
09h	THS3		THS3[7:0]									
0Ah	THS4		THS4[7:0]									
0Bh	THS5		THS5[7:0]									
0Ch	THS6		THS6[7:0]									
0Dh	THS7		THS7[7:0]									
0Eh	THS8		THS8[7:0]									
0Fh	THS9		THS9[7:0]									
1Ah	LPWK	Low-Power Wake Threshold	LPWK[7:0]								0001 0010	10~50
1Bh	ATRH	Adaptive Ref. Threshold	ATRH[7:0]								0000 0000	10~1024
1Ch	ATRL		ATRL[7:0]								1001 0110	
1Dh	LKTIME	Long-Key Reset Time	LKTIME[7:0]								0001 0000	1~60
1Eh	LPTIME	Low-Power Idle Time	LPTIME [7:0]								0000 0100	1~8
1Fh	LEDC1	LED Control	LED7	LED6	LED5	LED4	LED3	LED2	LED1	LED0	0000 0000	-
20h	LEDC2									LED8	0000 0000	-
22h	KEYL	Key Code	KEY7	KEY6	KEY5	KEY4	KEY3	KEY2	KEY1	KEY0	0000 0000	-
23h	KEYM								KEY9	KEY8	0000 0000	-
25h	KEYIF	Key Debounce Count	KEYIF[7:0]								0000 0010	1~10
26h	BUPH	Baseline Up Speed	BUPH[7:0]								0000 0101	1~250
27h	BUPL	Baseline Down Speed	BUPL[7:0]								0011 0010	1~250
28h	CMCT	CMOD Charge Time	CMCT[7:0]								0111 1000	16~250
29h	LPST	Low-Power Scan Interval	LPST[7:0]								0000 0010	1~8
2Ah	LEDST	LED Scan Time	LEDST[7:0]								0000 0110	4~10

● Control Register 1 (CTRL1, 01h)

BIT	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Name	MOD	LKEN	MKEN	LEDEN	LEDM	SLPEN	SRST	SETEN
Access	R/W							
Default	1	1	0	0	0	1	0	0

Bit[7] **MOD:** Threshold mode select

1: Adaptive threshold mode(recommended for uniform pad size & dielectric thickness)

0: Manual threshold mode

Bit[6] **LKEN:** Long-key reset enable

1: Enabled

0: Disabled

Bit[5] **MKEN:** Multi-key suppression enable

1: Enabled

0: Disabled

Bit[4] **LEDEN:** Touch-pin LED multiplex enable

1: Enabled

0: Disabled

Bit[3] **LEDM:** LED display mode

1: Hold mode (LED toggles on touch event)

0: Follow mode (LED on when touched, off when released)

Bit[2] **SLPEN:** Low-power mode enable

1: Enabled

0: Disabled

Bit[1] **SRST:** Software reset all touch channels

1: Enabled

0: Disabled

Bit[0] **SETEN:** Configuration apply(resets all touch channels simultaneously)

1: Enabled

0: Disabled

● Control Register2 (CTRL2, 02h)

BIT	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Name	-	-	-	CLK2T	LEDCM[1:0]		SLPIN	LDOEN
Access	R/W						W	R/W
Default	0	0	0	0	0	0	0	0

Bit[4] **CLK2T:** Touch clock selection

1: Enabled

0: Disabled

Bit[3:2] **LEDCM:** LED individual control mode

00: Disabled

01: Enabled channels = touch-controlled; disabled channels = GPIO-controlled

10: Enabled channels = common-scan single control; disabled channels = GPIO-controlled

11: All channels = common-scan single control

Note: Common-scan mode only valid when LEDEN = 1

Bit[1] **SLPIN:** Enter low-power mode immediately

1: Enabled

0: Disabled

Bit[0] **LDOEN:** Low-power LDO configuration enable

1: Enabled

0: Disabled

● **Touch Channel Enable Register 1 (THEN1, 03h)**

BIT	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Name	CH7EN	CH6EN	CH5EN	CH4EN	CH3EN	CH2EN	CH1EN	CH0EN
Access	R/W							
Default	0xFF							

Bit[7:0] **THEN1[7:0]:** Touch Channel Enable control Bit

1: Enabled

0: Disabled

● **Touch Channel Enable Register 2 (THEN2, 04h)**

BIT	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Name							CH9EN	CH8EN
Access	R/W							
Default	0x02							

Bit[7:0] **THEN2[7:0]:** Touch Channel Enable control Bit

1: Enabled

0: Disabled

● **Touch Channel Threshold Registers (THSx, 06h~0Fh)**

BIT	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Name	THSx[7:0]							
Access	R/W							
Default	0x40							

Bit[7:0] **THSx[7:0]:** Manual threshold for each channel (range: 0x14 ~ 0xFA).

Lower value = higher sensitivity

● **Low-Power Wake-Up Threshold (LPWK, 1Ah)**

BIT	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Name	LPWK[7:0]							
Access	R/W							
Default	0x12							

Bit[7:0] **LPWK[7:0]:** Wake-up threshold in manual mode (range: 0x0A ~ 0x32).

Lower value = easier wake-up

● **Adaptive Mode Reference Threshold (ATRH, 1Bh)**

BIT	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Name	ATRH[7:0]							
Access	R/W							
Default	0x00							

Bit[7:0] **ATRH[7:0]:** High byte of adaptive reference threshold

- **Adaptive Mode Reference Threshold (ATRL, 1Ch)**

BIT	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Name	ATRL[7:0]							
Access	R/W							
Default	0x96							

Bit[7:0] **ATRL[7:0]**: Low byte of adaptive reference threshold.
Combined value [ATRH:ATRL]; lower value = higher sensitivity

- **Long-Key Reset Time (LKTIME, 1Dh)**

BIT	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Name	LKTIME[7:0]							
Access	R/W							
Default	0x10							

Bit[7:0] **LKTIME[7:0]**: Long-Key Reset Time,unit: second

- **Low-Power Idle Time (LPTIME, 1Eh)**

BIT	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Name	LPTIME[7:0]							
Access	R/W							
Default	0x04							

Bit[7:0] **LPTIME[7:0]**: Idle duration (no touch / no I²C) before entering low-power mode.
unit: second

- **LED Control Registers 1 (LEDC1, 1Fh)**

BIT	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Name	LED7	LED6	LED5	LED4	LED3	LED2	LED1	LED0
Access	R/W							
Default	0x00							

Bit[7:0] **LED1[7:0]**: Controls multiplexed LED output per channel
1: LED on
0: LED off

- **LED Control Registers 2 (LEDC2, 20h)**

BIT	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Name	-	-	-	-	-	-	-	LED8
Access	R/W							
Default	0x00							

Bit[7:0] **LED2[7:0]**: Controls multiplexed LED output per channel
1: LED on
0: LED off

- **Key Code Registers (KEYL, 22h)**

BIT	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Name	KEY7	KEY6	KEY5	KEY4	KEY3	KEY2	KEY1	KEY0
Access	R							
Default	0x00							

Bit[7:0] **KEYL[7:0]:** Key Code

- **Key Code Registers (KEYM, 23h)**

BIT	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Name	-	-	-	-	-	-	KEY9	KEY8
Access	R							
Default	0x00							

Bit[7:0] **KEYM[7:0]:** Key Code

- **Key Debounce Count (KEYIF, 25h)**

BIT	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Name	KEYIF[7:0]							
Access	R/W							
Default	0x02							

Bit[7:0] **KEYIF[7:0]:** Number of debounce samples for touch detection.
Higher value = slower but more stable response

- **Baseline Update Speed Registers (BUPH, 26h)**

BIT	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Name	BUPH[7:0]							
Access	R/W							
Default	0x05							

Bit[7:0] **BUPH[7:0]:** Baseline rising update speed

- **Baseline falling update speed (BUPL, 27h)**

BIT	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Name	BUPL[7:0]							
Access	R/W							
Default	0x32							

Bit[7:0] **BUPL[7:0]:** Baseline falling update speed

- **CMOD Charge Time (CMCT, 28h)**

BIT	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Name	CMCT[7:0]							
Access	R/W							
Default	0x78							

Bit[7:0] **CMCT[7:0]:** Charging time for CMOD capacitor.
Larger CMOD capacitor requires higher CMCT value

● **Low-Power Scan Interval (LPST, 29h)**

BIT	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Name	LPST[7:0]							
Access	R/W							
Default	0x02							

Bit[7:0] LPST[7:0]: Scan interval in low-power mode = LPST × 16ms
 Higher value = longer interval, lower power, slower wake-up response

● **LED Scan Time (LEDST, 2Ah)**

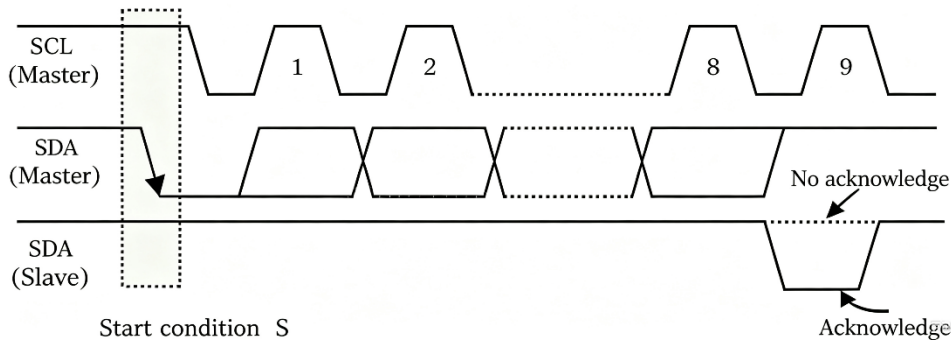
BIT	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Name	LEDST[7:0]							
Access	R/W							
Default	0x06							

Bit[7:0] LEDST[7:0]: LED scan period = LEDST × 0.5ms
 Higher value = longer scan interval, lower LED brightness (range: 0x04 ~ 0x0A)

6. I²C Communication Protocol

6.1 Protocol Overview

- Compliant with standard I²C protocol, maximum speed: 100K/S
- Supports continuous read and write operations



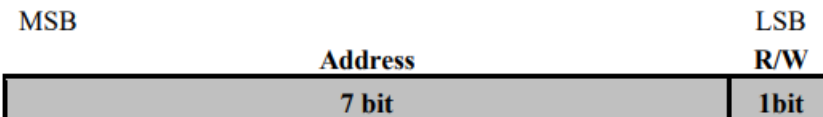
Note: For GPIO-simulated I²C, ensure SDA/SCL edge interval > 250ns.

```
IO_SDA=0;
DELAY_NS(250); // edge interval > 250ns
IO_SCL=0;
```

6.2 Slave Address

- Slave Address CHIP_ID

CHIP_ID	Address(7bit)+R/W(1bit)
CHIP_ID	0XE0



6.3 Write Operation

- Write x bytes starting from register address 0x03:

Start	Device Address 0XE0	ACK	Register Address 0x03	ACK	DATA n	ACK	...	DATA n+x	ACK	Stop
-------	------------------------	-----	--------------------------	-----	-----------	-----	-----	-------------	-----	------

6.4 Read Operation

- Write target register address (e.g. 0x22):

Start	Device Address 0XE0	ACK	Register Address 0x22	ACK
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Sent by Master

Sent by Slave

- Read x bytes starting from register n=0x22:

Start	Device Address 0XE1	ACK	Data read n	ACK	...	Data read n+x	NACK	Stop
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7. Application Circuit

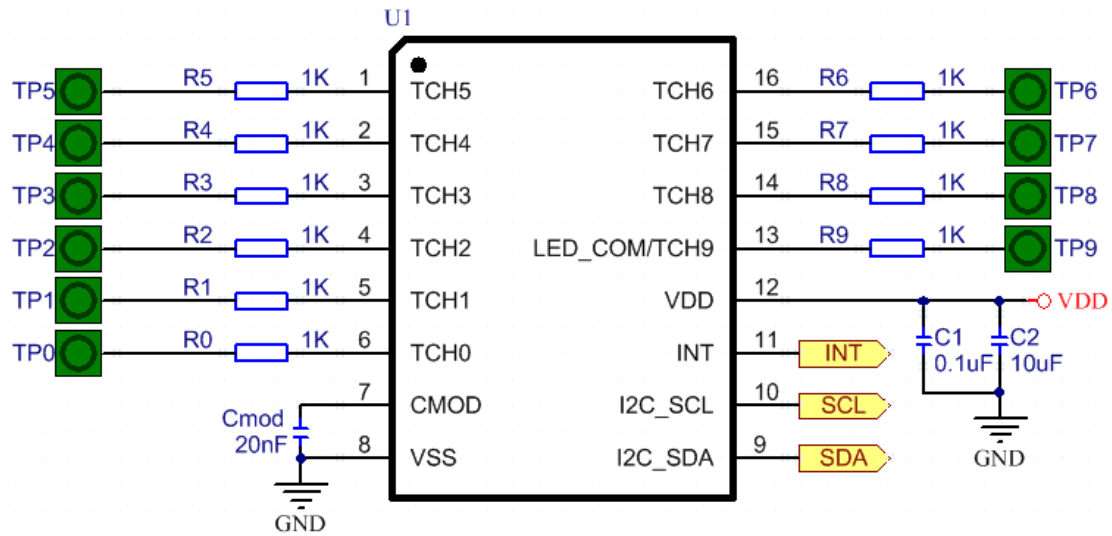


Figure3 Typical Application Circuit

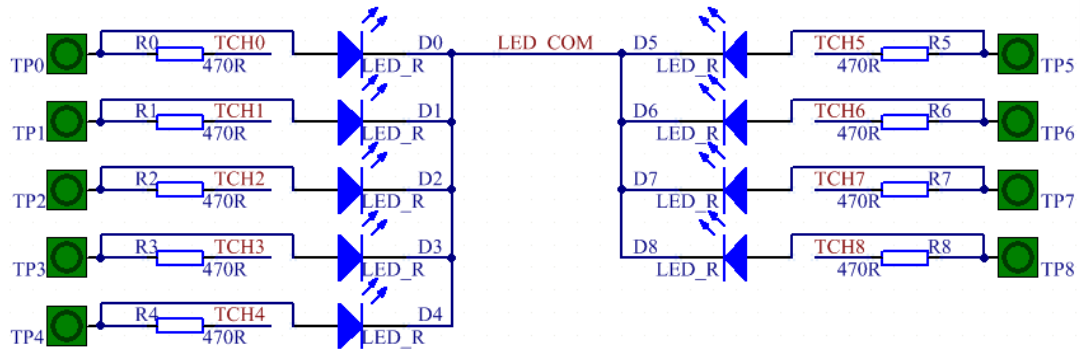


Figure4 Typical Touch-Multiplexed LED Drive Circuit

Note:

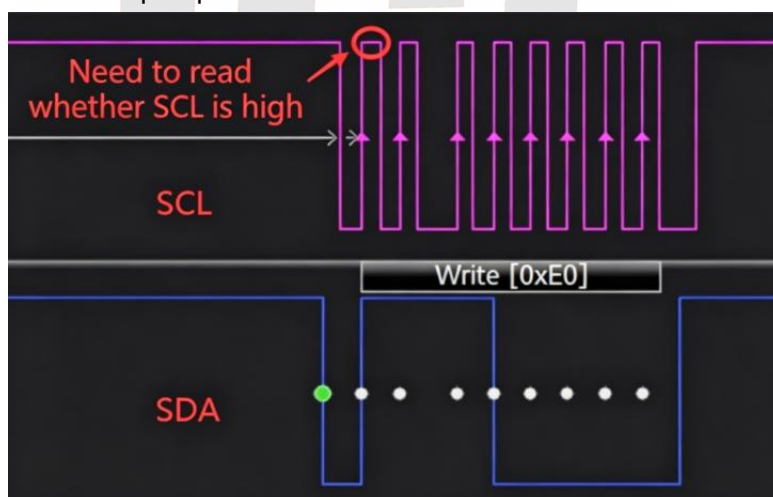
Adjust CMOD capacitor (4.7nF ~ 47nF) to tune sensitivity when dielectric material/thickness varies. Larger capacitance = higher sensitivity. Values below are for reference only.

Table3 CMOD Capacitor Tuning Reference (No LED Multiplex)

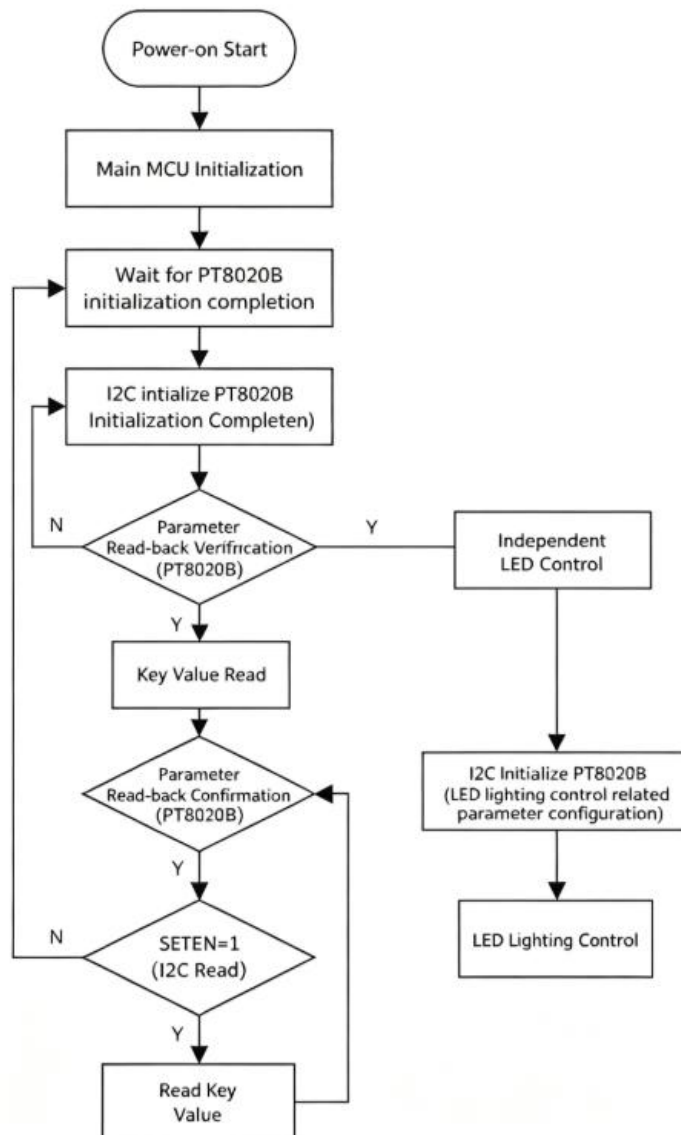
Acrylic Thickness	Touch Pad Size	CMOD Capacitance
1mm	10*10mm	6.8nF
2mm	10*10mm	10nF
3mm	10*10mm	15nF
4mm	10*10mm	20nF
5mm	10*10mm	33nF
6mm	10*10mm	47nF

8. Application Notes

- Increase CMOD capacitance or lower threshold via I²C to boost touch sensitivity.
- After I²C configuration, set SETEN = 1 to apply parameters; this also resets all touch channels. LED control and key code registers take effect immediately, independent of SETEN.
- Wait at least 4s after first power-up for environmental calibration before low-power entry; otherwise false wake-up may occur.
- If LED flickers, increase LEDST register value.
- Adaptive mode only compensates for trace length variation, not for differing touch pad sizes.
- No non-volatile memory; all configurations must be reinitialized after power cycle.
- First I²C command after low-power entry may be ignored; second command will work normally.
- I²C_SDA and I²C_SCL integrate 5kΩ internal pull-up resistors.
- For 100 kbps software I²C, use open-drain SCL output and verify first clock pulse is not forced low. 50 kbps operation has no such restriction.

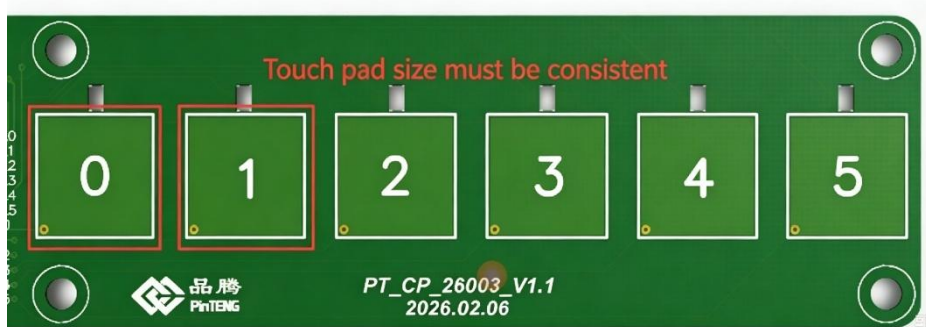


9. Host Software Flowchart

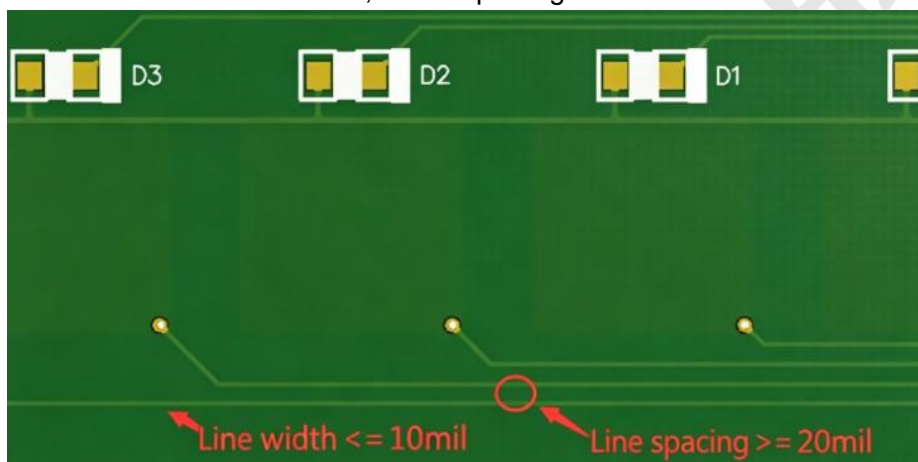


10. Touch PCB Layout Guidelines

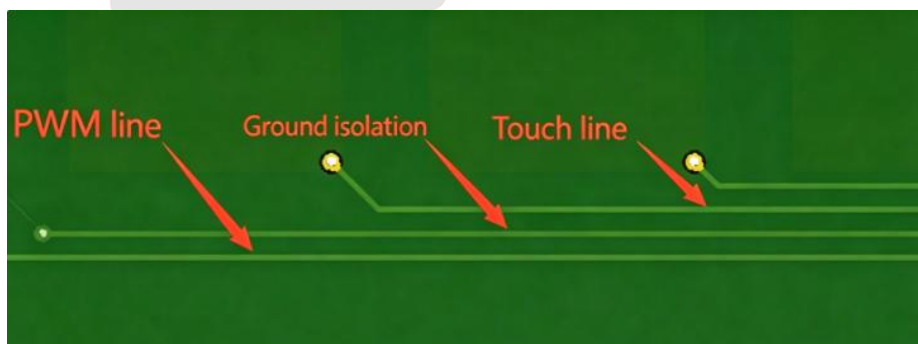
- Touch pads must be uniform in size; otherwise adaptive algorithm cannot compensate.



- Touch trace width ≤ 10 mil; trace spacing ≥ 20 mil to minimize crosstalk.



- Routing touch traces on the back side of the pad has negligible impact on sensitivity.
- Avoid ground pour around pads/traces if no interference source is present, as it reduces sensitivity.
 - Use ground plane isolation in the following cases:
 1. Back side of touch pad contacts enclosure, battery or other parasitic capacitance sources.
 2. Touch traces run parallel to PWM or high-frequency signals; add ground trace between them or keep spacing ≥ 20 mil.



3. Isolate touch traces/pads between two touch ICs with ground to prevent mutual interference.

11. Electrical Specifications

11.1 Absolute Maximum Ratings

Table4 Absolute Maximum Ratings

Parameter	Symbol	Condition	Range	Unit
Supply Voltage	V_{DD}	-	-0 to +6.0	V
Input Voltage	V_I	All I/O pins	-0.3 to $V_{DD} + 0.3$	V
Operating	T_A	-	-40 to + 85	°C
Storage	T_{STG}	-	-50 to + 125	°C

11.2 DC Characteristics

Table5 DC Characteristics (Conditions: $V_{DD} = 2.4V \sim 5.5V$, $T_A = 25^\circ C$ unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Operating Voltage	V_{DD}		2.4		5.5	V
Input High Level	V_{IH}		$0.7V_{DD}$			V
Input Low Level	V_{IL}				$0.3 V_{DD}$	V
Source Current	I_{OH}	$V_{DD}=5V$, $VOH=0.7V_{DD}$		15		mA
Sink Current	I_{OL}	$V_{DD}=5V$, $VOL=0.3V_{DD}$		30		mA
Normal Mode Current	I_{LP}	$V_{DD}=5V$, $C_{mod}=10nF$		15		uA
		$V_{DD}=3V$, $C_{mod}=10nF$		7		uA
	I_{Nm}	$V_{DD}=5V$, $C_{mod}=10nF$		2.5		mA
		$V_{DD}=3V$, $C_{mod}=10nF$		1.5		mA
Normal Mode Response	T_{NRT}	$V_{DD}=5V$, $C_{mod}=10nF$ default config, 10ch enabled			90	ms
Low-Power Response	T_{LRT}	$V_{DD}=5V$, $C_{mod}=10nF$ default config, 10ch enabled			160	ms

12. Package Dimensions

12.1 SOP16 Package

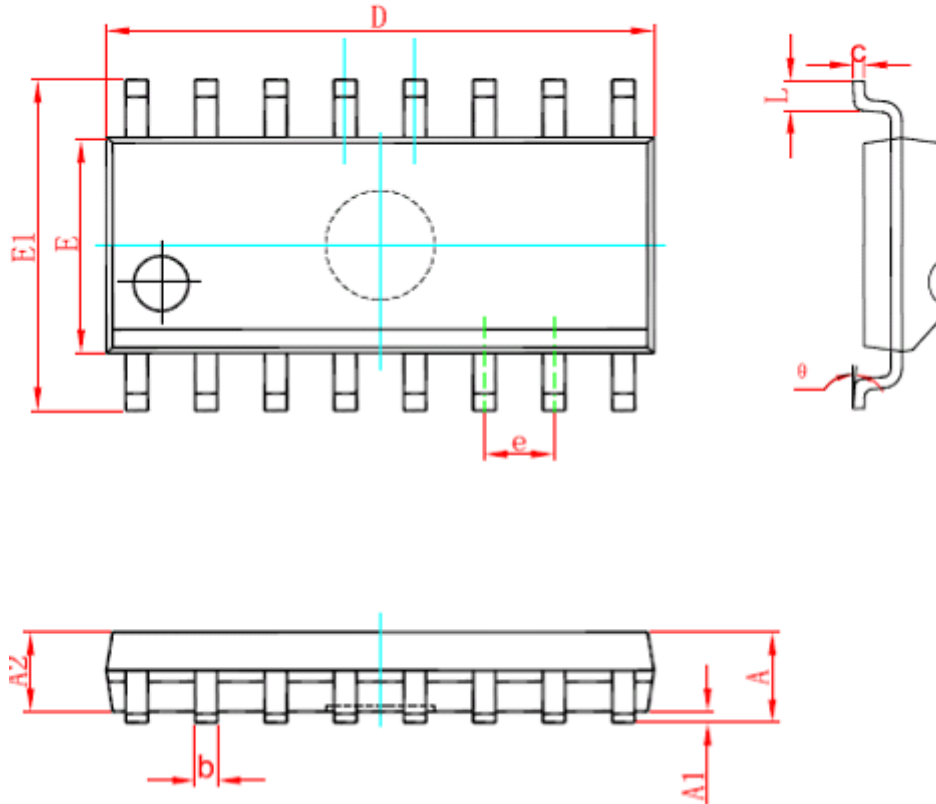


Figure5 SOP16 Outline Drawing

Table6 SOP16 Package Dimensions

Symbol	Dimensions (mm)			Symbol	Dimensions (Inches)		
	Min.	Typ.	Max.		Min.	Typ.	Max.
A	1.35	-	1.75	A	0.053	-	0.069
A1	0.10	-	0.25	A1	0.004	-	0.010
A2	1.35	-	1.55	A2	0.053	-	0.061
b	0.33	-	0.51	b	0.013	-	0.020
c	0.17	-	0.25	c	0.007	-	0.010
D	9.80	-	10.2	D	0.386	-	0.402
E	3.80	-	4.00	E	0.150	-	0.157
E1	5.80	-	6.20	E1	0.228	-	0.244
e	-	1.270	-	e	-	0.050	-
L	0.40	-	1.27	L	0.016	-	-
θ	0°	-	8°	θ	0°	-	8°

12.2 QFN16 Package

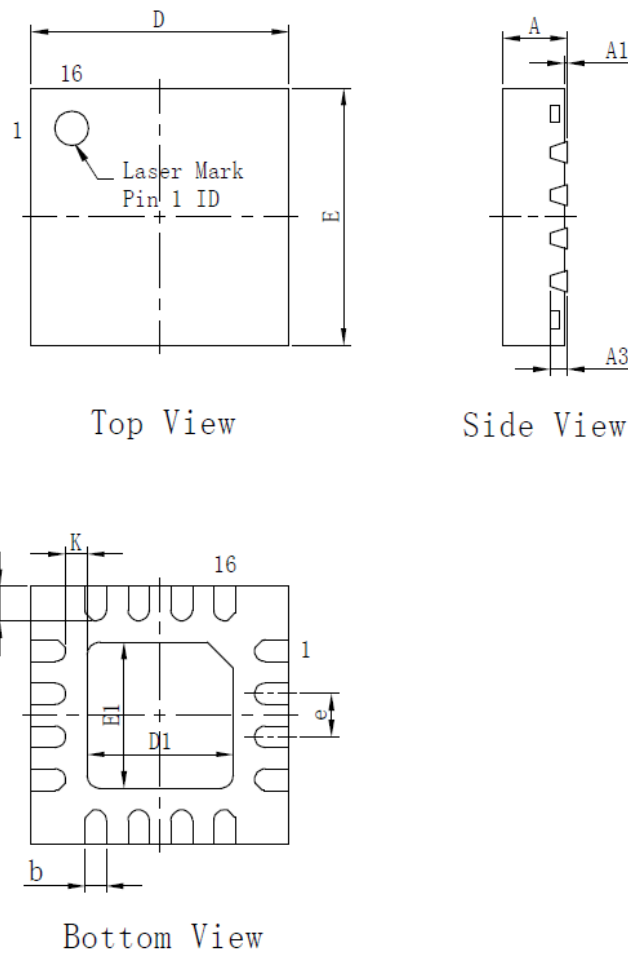


Figure6 QFN16 Outline Drawing

Table7 QFN16 Package Dimensions

Symbol	Dimensions (mm)		
	Min.	Typ.	Min.
A	0.70	0.75	0.80
A1	0.00	-	0.05
A3	0.203REF		
b	0.20	0.25	0.30
D	2.90	3.00	3.10
E	2.90	3.00	3.10
D1	1.60	1.70	1.80
E1	1.60	1.70	1.80
e	0.50TYP		
K	0.20	-	-
L	0.30	0.40	0.50

13. Revision History

Version	Description	Release Date
V1.0	Initial release	2026-01-05
V1.1	1. Added key response time parameters in DC characteristics 2. Corrected I ² C device address typo	2026-04-22

The latest official version shall prevail; please download the latest document from the official website regularly!