4 Keys Touch Pad Detector IC

Outline

- The TTP224C TonTouch^{TM} IC is capacitive sensing design specifically for touch pad controls. The device built in regulator for touch sensor.
  Stable sensing method can cover diversity conditions.
  Human interfaces control panel links through non-conductive dielectric material.
  The main application is focused at replacing of the mechanical switch or button.
 The ASSP can independently handle the 4 touch pads with 4 direct output pins

Characteristic

- Operating Voltage 2.4V ~ 5.5V
- Built-in Regulator
- Operating Current @VDD=3V no load
  At Low Power mode typical 2.5uA，At Fast mode typical 13uA
- Operating Voltage @VDD=3V：
  The response time about 160mS at Low Power mode，60mS at Fast mode
- Sensitivity can adjust by the capacitance (1~50pF)outside for each touch pad
- Provides Fast mode and Low Power mode selection by pad option (LPMB pin)
- Provides Direct mode or Toggle mode、CMOS output or Open Drain output、
  active High or active Low by pad option (TOG/OD/AHLB pin)
- Provides Single-key and Multi-key functions by pad option (SM pin)
- Have the maximum on time　16sec/infinite by pad option(MOT0 pin)
  [Internal IC by **MOT1** default　**1** (eFuse No-Write **Bit-5**)]
- Have the maximum on time　120sec/64sec by pad option(MOT0 pin)
  [Internal IC by **MOT1** setting　**0** (eFuse Write **Bit-5**)]
- **4-Keys**(TP0~TP3) Touch Input & **4** Output(TPQ0~TPQ3)
  [Internal IC by **DIS_TP13** default　**0** (eFuse No-Write **Bit-6**)]
- **2-Keys**(TP0　TP2) Touch Input & **2** Output(TPQ0　TPQ2)
  [Internal IC by **DIS_TP13** setting　**1** (eFuse Write **Bit-6**)]
- After Power-ON has about 0.5sec stable-time，during the time do not touch the key pad，and the function is disabled
- Auto calibration for life
- The re-calibration period is about 1 sec within 8 sec after Power-ON.
  When key has been touched within 8 sec or key has not been touched more than 8 sec after Power-ON，then the re-calibration period change to 4 sec

Applications

- Wide consumer products
- Button key replacement

Block Diagram
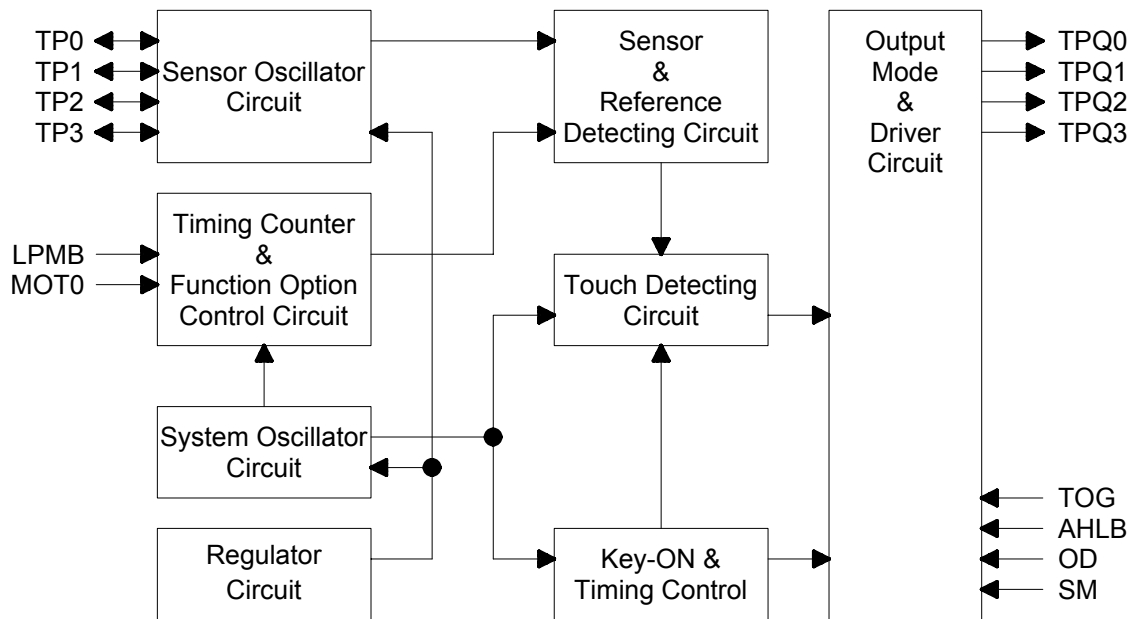
Pin Description

Pad NO	Pad Name	Type	Pad Description
1	TP0	I/O	Touch pad input pin
2	TP1	I/O	Touch pad input pin
3	TP2	I/O	Touch pad input pin
4	TP3	I/O	Touch pad input pin
5	AHLB	I-PL	Output active High or Low option, default: 0
6	VDD	P	Positive Power Supply
7	TOG	I-PL	Output type option，default：0
8	LPMB	I-PL	Low power/Fast mode option，default：0
9	MOT0	I-PH	Key Maximum on time option，default：1
10	VSS	P	Negative Power Supply，Ground
11	OD	I-PH	Output Open-Drain option，default：1
12	SM	I-PH	Single/Multi key option，default：1
13	TPQ3	O	Direct output for TP3 touch input pin
14	TPQ2	O	Direct output for TP2 touch input pin
15	TPQ1	O	Direct output for TP1 touch input pin
16	TPQ0	O	Direct output for TP0 touch input pin

Pin Type

- I   CMOS input only
- O   CMOS push-pull output
- I/O   CMOS I/O
- P   Power/Ground

- I-PH   CMOS input and pull-high resister
- I-PL   CMOS input and pull-low resister
- OD   Open-Drain output，have no Diode protective circuit

Pad's Diagram
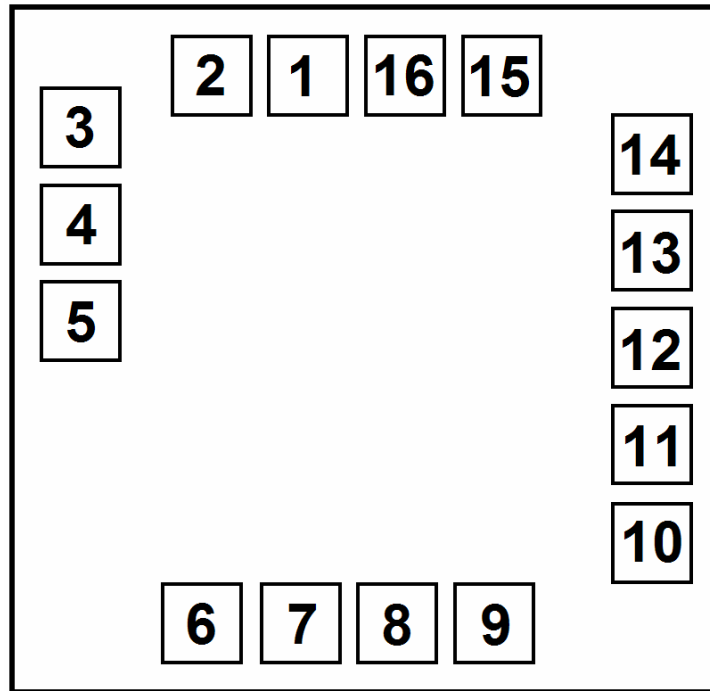
Chip Size **830**um x **805**um
Substrate **Floating**(recommend) or **VSS**

Pad's Coordinate

Pad No.	Pad Name	X	Y
1	TP0	-62.990	297.000
2	TP1	-167.990	297.000
3	TP2	-309.500	240.590
4	TP3	-309.500	135.590
5	AHLB	-309.500	30.590
6	VDD	-178.470	-297.000
7	TOG	-71.470	-297.000
8	LPMB	33.530	-297.000
9	MOT0	138.530	-297.000
10	VSS	309.500	-210.000
11	OD	309.500	-103.000
12	SM	309.500	2.000
13	TPQ3	309.500	107.000
14	TPQ2	309.500	212.000
15	TPQ1	147.010	297.000
16	TPQ0	42.010	297.000

Electrical Characteristics

- **Absolute maximum ratings**

Parameter	Symbol	Conditions	Rating	Unit
Operating Temperature	T_{OP}	—	$-40 \sim +85$	℃
Storage Temperature	T_{STG}	—	$-50 \sim +125$	℃
Supply Voltage	VDD	Ta=25°C	VSS-0.3~VSS+5.5	V
Input Voltage	V_{IN}	Ta=25°C	VSS-0.3~VDD+0.3	V
Human Body Mode	ESD	—	$\geqq$**4**	KV
Note：VSS symbolizes for system ground				

- **DC / AC characteristics：(Test condition at room temperature = 25 ℃)**

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Operating Voltage	VDD		2.4	3.0	5.5	V
Internal Regulator Output	VREG		2.2	2.3	2.4	V
Operating Current	I_{OPL}	VDD=3V(No-Load)，At Low Power mode		2.5		uA
	I_{OPF}	VDD=3V(No-Load)，At Fast mode		13.0		uA
Input Ports	V_{IL}	Input Low Voltage	0		0.2	VDD
Input Ports	V_{IH}	Input High Voltage	0.8		1.0	VDD
Output Port Sink Current	I_{OL}	VDD=3V，V_{OL}=0.6V		8		mA
Output Port Source Current	I_{OH}	VDD=3V，V_{OH}=2.4V		-4		mA
Input Pin Pull-high Resistor	R_{PH}	VDD=3V		30K		ohm
Input Pin Pull-low Resistor	R_{PL}	VDD=3V		25K		ohm
Output Response Time	T_R	VDD=3V、At Fast mode		60		mS
		VDD=3V、At Low Power mode		160		

Function Description

Ⅰ. Sensitivity adjustment

The total loading of electrode size and capacitance of connecting line on PCB can affect the sensitivity.

So the sensitivity adjustment must according to the practical application on PCB.

The TTP224C offers some methods for adjusting the sensitivity outside

1. By the electrode size
    Under other conditions are fixed.
    Using a larger electrode size can increase sensitivity.
    Otherwise it can decrease sensitivity.
    But the electrode size must use in the effective scope

2. By the panel thickness
    Under other conditions are fixed.
   Using a thinner panel can increase sensitivity.
    Otherwise it can decrease sensitivity.
    But the panel thickness must be below the maximum value

3. By the value of Cs0~Cs3 (please see the down figure)
   Under other conditions are fixed.
    Add the capacitors Cs0~Cs3 can fine tune the sensitivity for single key, that lets all key's sensitivity identical. When do not use any capacitor to VSS, the sensitivity is most sensitive. When adding the values of Cs0~Cs3 will reduce sensitivity in the useful range($1 \leqq Cs0 \sim Cs3 \leqq 50pF$)

ELECTRODE
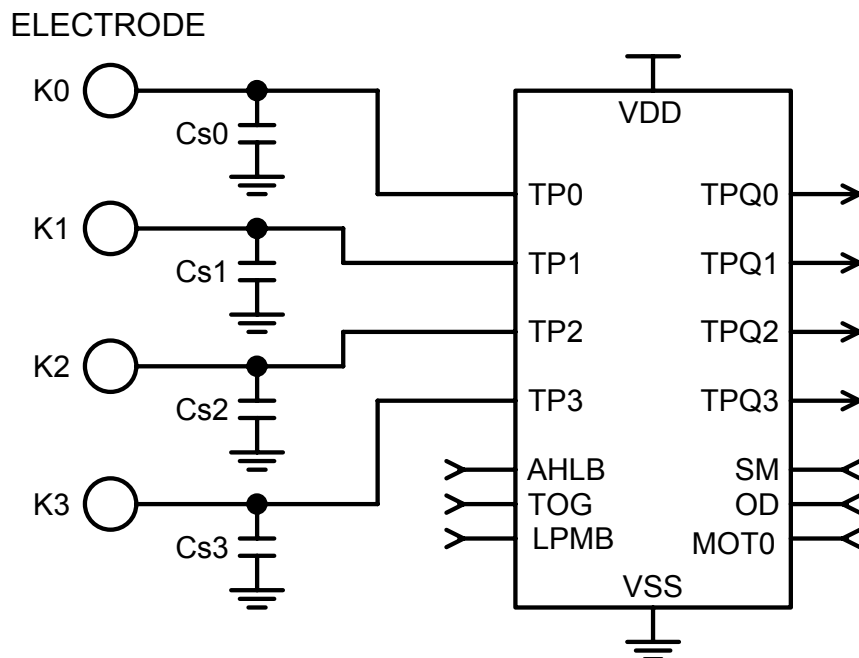
Ⅱ. Output mode (By TOG　OD　AHLB pad option)

The TTP224C outputs(TPQ0~TPQ3)has direct mode active High or Low by AHLB pad option，has Toggle mode by TOG pad option and has Open-Drain
(have diode protective circuit) mode by OD pad option

TOG	OD	AHLB	Pad　TPQ0 ～ TPQ3 option features	Remark
0	1	0	Direct mode，CMOS output active High	Default
0	1	1	Direct mode，CMOS output active Low	
0	0	0	Direct mode，Open-Drain output active High	
0	0	1	Direct mode，Open-Drain output active Low	
1	1	0	Toggle mode，CMOS output，Power-ON State=0	
1	1	1	Toggle mode，CMOS output，Power-ON State=1	
1	0	0	Toggle mode，Power-ON State High-Z，active High	
1	0	1	Toggle mode，Power-ON State High-Z，active Low	
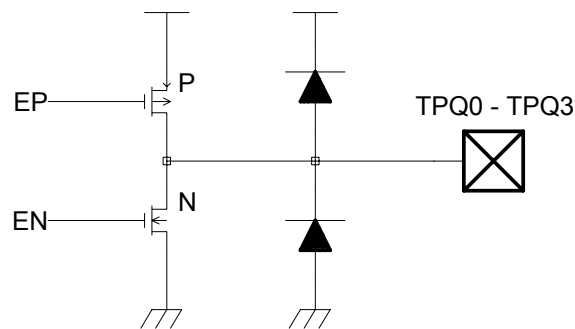
Ⅲ. Key operating mode (By SM pad option)

The TTP224C has the Single-key and Multi-key functions by SM pad option

SM	Option features	Remark
1	Multi-key mode	Default
0	Single key mode	

Multi-key mode：The TP0-TP3 can be detected 2 keys or above 2 keys at the same time
Single-key mode： The TP0-TP3 can be detected 1 key only at the same time，
　　　　　　　when any key be detected，the other 3 keys can not be detected

Ⅳ. Maximum key on duration time (By MOT0 pad option)

If some objects cover in the sense pad，and causing the change quantity enough to be detected. To prevent this，the TTP224C sets a timer to monitor the detection.
The timer is the maximum on duration time. When the detection is over the timer，
the system will return to the Power-ON initial state，and the output becomes inactive until the next detection

MOT1	MOT0	Option features	Remark
0	0	Maximum on time 120 sec	
0	1	Maximum on time 64 sec	
1	0	Maximum on time 16 sec	
1	1	Infinite（Disable Maximum on time）	Default

[**MOT1** default　**1** (eFuse No-Write **Bit-5**)] & [**MOT1** setting　**0** (eFuse Write **Bit-5**)]

Ⅴ. Fast and Low power mode select (By LPMB pad option)

The TTP224C has Fast mode and Low Power mode to be selected.
It depends onthe state of LPMB pad.
When the LPMB pin is connected to VDD　the TTP224C runs in Fast mode.
When the LPMB pin is opened or connected to VSS
the TTP224C runs in Low Power mode.
In the Fast mode response time is faster　but the current consumption will be increased.
In the Low Power mode it will be saving power　but will be slowing response time for first
touch. When it awaked in Fast mode　the response time is the same the Fast mode.
In this mode when detecting key touch　it will switch to Fast mode. Until the key touch is
released and will keep a time about 8sec. Then it returns to Low Power mode.

The states and timing of two modes please see below figure.
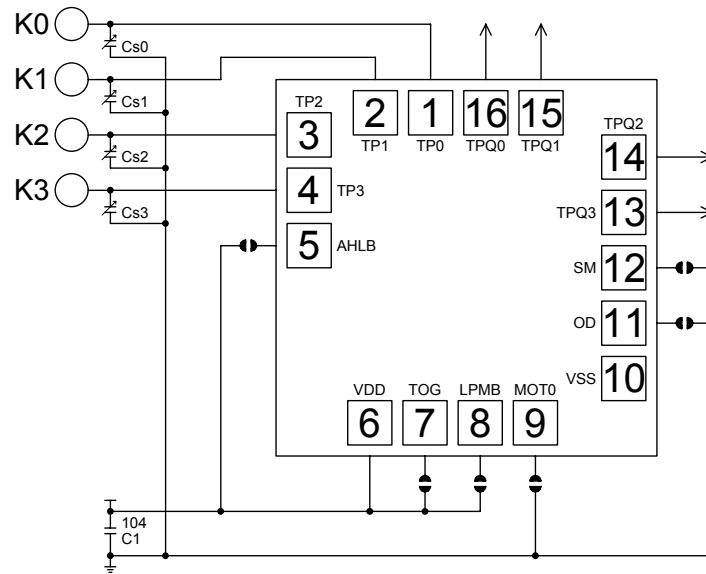
1. Low Power mode timing diagram：
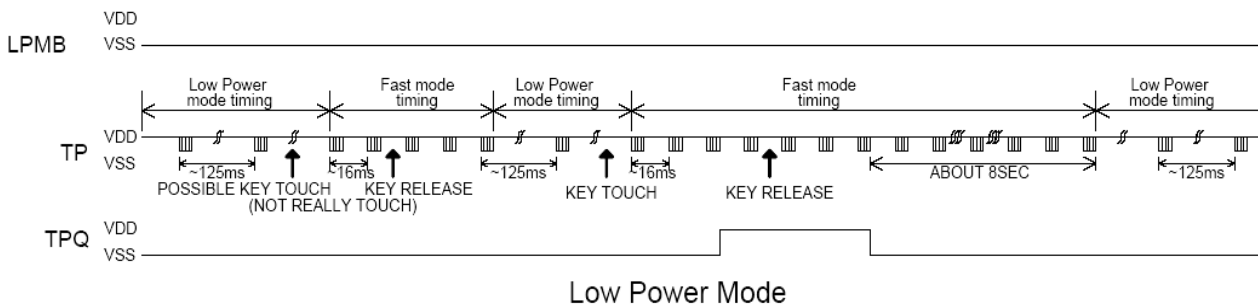
Low Power Mode

2. Fast mode timing diagram:
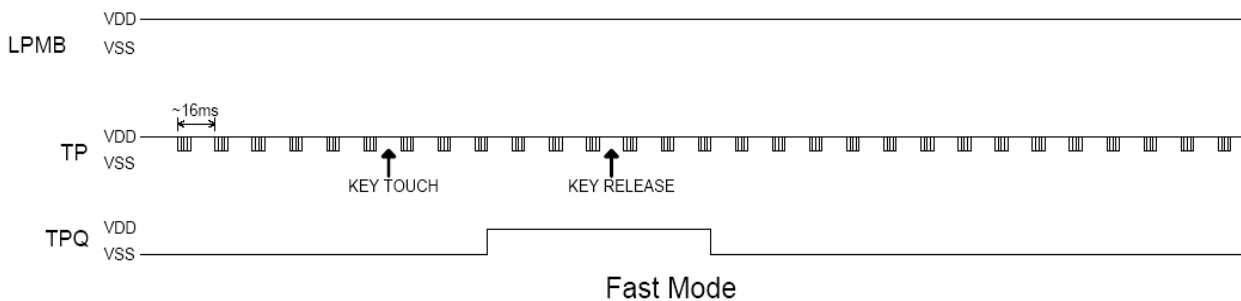
Fast Mode

LPMB	Option features	Remark
1	Fast mode	
0	Low Power mode	Default

Application circuit

Option Table

Output Mode

TOG	OD	AHLB	Pad TPQ0-TPQ3 Option Features
Open	Open	Open	Direct mode，CMOS output active High
Open	Open	VDD	Direct mode，CMOS output active Low
Open	VSS	Open	Direct mode，Open-Drain output active High
Open	VSS	VDD	Direct mode，Open-Drain output active Low
VDD	Open	Open	Toggle mode，CMOS output，Power-ON State=0
VDD	Open	VDD	Toggle mode，CMOS output，Power-ON State=1
VDD	VSS	Open	Toggle mode，Power-ON State High-Z，active High
VDD	VSS	VDD	Toggle mode，Power-ON State High-Z，active Low

Key Operation Mode

SM	Option Features
Open	Multi-key mode
VSS	Single key mode

Fast and Low Power Mode

LPMB	Option Features
Open	Low Power mode
VDD	Fast mode

Maximum key on duration time (By MOT0 pad option)

MOT1	MOT0	Option features	Remark
0	VSS	Maximum on time 120 sec	
0	Open	Maximum on time 64 sec	
1	VSS	Maximum on time 16 sec	
1	Open	Infinite（Disable maximum on time）	Default

[**MOT1** default   **1** (eFuse No-Write **Bit-5**)] & [**MOT1** setting   **0** (eFuse Write **Bit-5**)]

P.S.

1. On PCB，the length of lines from touch pad to IC pin shorter is better.
   And the lines do not parallel and cross with other lines.
2. The power supply must be stable.
   If the supply voltage drift or shift quickly   maybe causing sensitivity anomalies or false detections.
3. The material of panel covering on the PCB can not include the metal or the electric element.
   The paints on the surfaces are the same.
4. The C1 capacitor must be used between VDD and VSS   and should be routed with very short tracks
   to the device's VDD and VSS pins (TTP224C).
5. The capacitance Cs0~Cs3 can be used to adjust the sensitivity.
   The value of Cs0~Cs3 use smaller   then the sensitivity will be better.
   The sensitivity adjustment must according to the practical application on PCB.
   The range of Cs0~Cs3 value are 1~50pF.
6. The sensitivity adjustment capacitors(Cs0~Cs3)must use smaller temperature coefficient and more
   stable capacitors. Such are **X7R   NPO** for example.
   So for touch application   recommend to use **NPO** capacitor   for reducing that the temperature varies
   to affect sensitivity.

Package outline

Package Type：**SSOP-20**
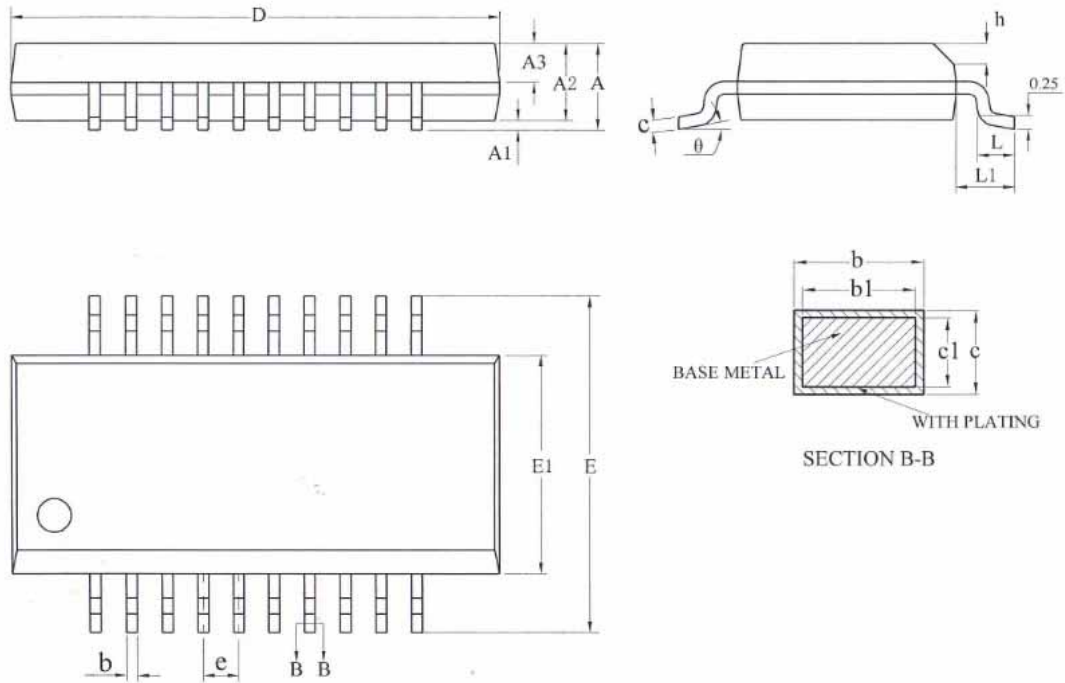
Symbol Parameter (Unit : mm)														
A			A1			A2			A3			b		
Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
		1.75	0.10	0.15	0.25	1.30	1.40	1.50	0.60	0.65	0.70	0.23		0.31

Symbol Parameter (Unit : mm)														
b1			c			c1			D			E		
Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max	Min	Nom	Max
0.22	0.25	0.28	0.20		0.24	0.19	0.20	0.21	8.55	8.65	8.75	5.80	6.00	6.20

Symbol Parameter (Unit : mm)													
E1			e		h			L			L1	θ	
Min	Nom	Max	Typ		Min	Nom	Max	Min	Nom	Max	Typ	Min	Nom	Max
3.80	3.90	4.00	0.635 BSC		0.30		0.50	0.50		0.80	1.05 REF	0		8°

Package configuration

TTP224C-ASD & TTP224C-ASDN
Package Type：**SSOP-20**

Pin configuration (SSOP-20):

Top side pins (left to right, 20 to 11): TPQ0, TPQ1, TPQ2, TPQ3, SM, OD, VSS, MOT0

Pins 20, 19, 18, 17, 16, 15, 14, 13, 12, 11

Pins 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

Bottom side pins (left to right, 1 to 10): TP0, TP1, TP2, TP3, AHLB, VDD, TOG, LPMB
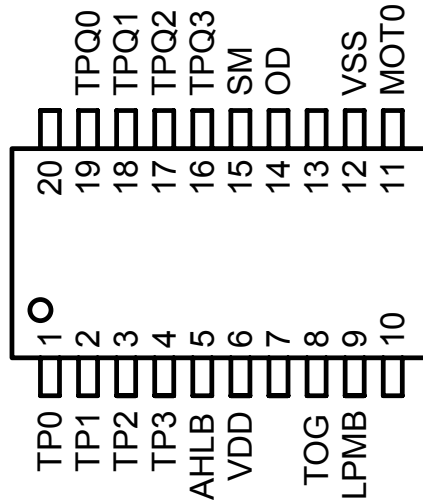
Ordering Information

TTP224C

Package Type	Chip Type	Wafer Type
TTP224C-XXX	TCP224C	TEP224C

Revision History

1. 2021/01/20
   -Original Version   Ver 1.0