DC LED lightness regulation controller

&

1 key Touch Pad Detector IC

Outline

- TTP118-AO8 can be a single-channel touch chip for DC LED lightness regulation.
- TTP118-AO8 is a touch pad detector IC which offers 1 touch key. Stable sensing method can cover diversity conditions. The touching detection IC is designed for replacing traditional direct button key with diverse pad size. Low power consumption and wide operating voltage are the contact key features for DC or AC application.

Characteristic

- Operating voltage 2.4V ~ 5.5V.

- Built-in power on initial(POR) and low voltage reset (LVR) function

- Lower Operating Current (no load)
  @VDD=3.3V, typical 4.0uA, maximum 8uA
  @VDD=5.0V, typical 8.0uA, maximum 16uA

- Sensitivity can adjust by the capacitance（1~47nF）outside.

- High applicability. Touching function is still effective with the existence of medium (such as glass, acrylic, plastic, ceramic, etc.) isolation.

- Stable touching detection of human body for replacing traditional direct switch key.

- Lightness regulation could be regulated optionally on a wide range with a low operational difficulty.

- Lightness regulation could be high frequency PWM with 31KHz @VDD=5.0V.

- Support 8 functions could be selected by MODE, OPT1, OPT2.

- Auto calibration for life
  The re-calibration period is about 62.5 milliseconds within 4 seconds after power-on. Power on after 4 seconds then it returns to standby mode, then the re-calibration period change to about 1 second.

Applications

- Wide consumer products；Button key replacement

- LED lightness regulation

Pin assignment

SOP-8
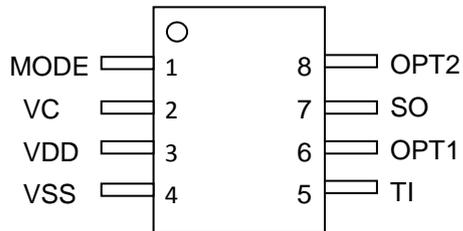
Pin Description

Pin no.	Pin name	Share Pin	Type	Pin Description
1	MODE	-	I-PH	Output type selection: 1 (Default) → DC LED lightness regulation output 0 →1key Touch PAD output
2	VC	-	I/O	Capacitance detection
3	VDD	-	P	Positive power supply
4	VSS	-	P	Negative power supply, ground
5	TI	-	I/O	Input sensor port
6	OPT1	TOGB	I-PH	MODE=1(Default) : OPT1→ DC LED lightness regulation output selection MODE=0 : TOGB→ 1 key detect direct output or toggle output selection
7	SO	-	O	CMOS output pin
8	OPT2	AHLB	I-PH	MODE=1(Default) : OPT2→ DC LED lightness regulation output selection MODE=0 : AHLB→ 1 key detect output active high or active low selection

Pin Type

- I   COMS input only
- O   CMOS push-pull output
- I/O   COMS 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

Block diagram
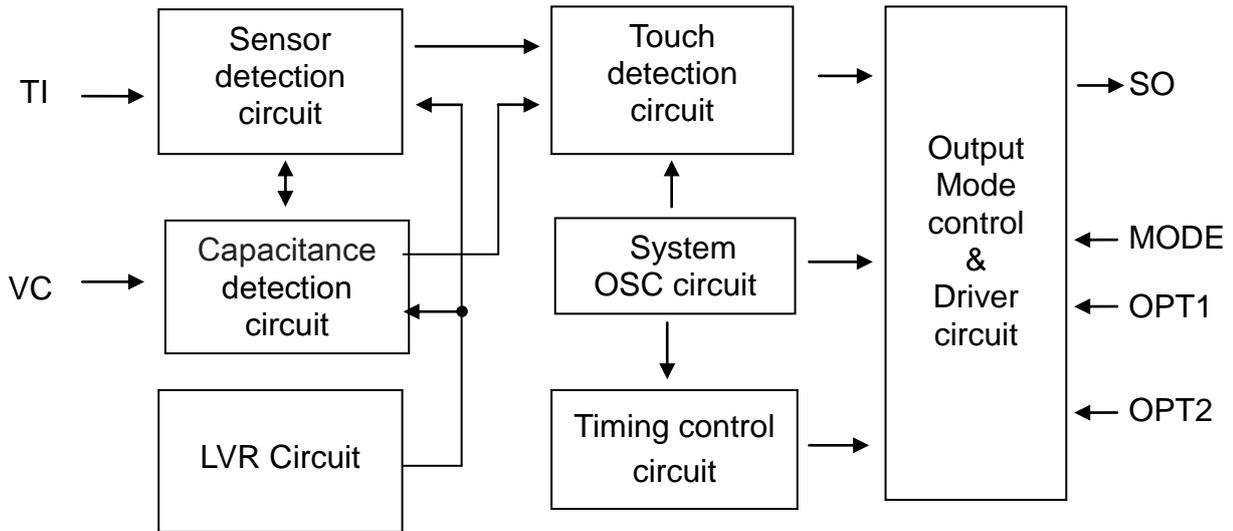
Electrical Characteristics

- **Absolute maximum ratings**

| Parameter	Symb	Conditions	Rating	Unit
Operating Temperature	T_{OP}	—	-40～+85	℃
Storage Temperature	T_{STG}	—	-50～+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	—	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	3.3	5.5	V
System oscillator	F_{OSC}	VDD=5.0V		-	16K	-	Hz
Operating Current (Standby mode)	I_{OPL}	VDD=3.3V, VC=10nF		-	4.0	8.0	uA
		VDD=5.0V, VC=10nF		-	8.0	16.0	uA
Input Ports	V_{IH}	Input High Voltage		2/3	-		VDD
	V_{IL}	Input Low Voltage			-	1/3	VDD
Output Port Source Current	I_{OH}	VDD=3.3V, V_{OH}=2.8V		-	-3.5	-	mA
		VDD=5.0V, V_{OH}=4.5V		-	-5.0	-	mA
Output Port Sink Current	I_{OL}	VDD=3.3V, V_{OL}=0.5V		-	8.0	-	mA
		VDD=5.0V, V_{OL}=0.5V		-	12.0	-	mA
SO PWM Frequency	F_{PWM}	VDD=5.0V		-	31K	-	Hz
Output Response Time	T_R	VDD=5.0V at standby mode	DC LED lightness	-	96	-	mS
			1key touch pad	-	132	-	mS
		VDD=5.0V, at detective mode		-	48	-	mS

Function Description

Ⅰ. Sensitivity adjustment

The total loading of electrode size and capacitance of connecting line on PCB can affect the sensitivity. C_S the sensitivity adjustment must according to the practical application on PCB. The TTP118 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 C_S（please see the down figure）
   Under other conditions are fixed. PAD VC to VSS capacitor Cs can adjust sensitivity, When adding the value of C_S will increase sensitivity in the useful range（$1nF \leqq C_S \leqq 47nF$）.
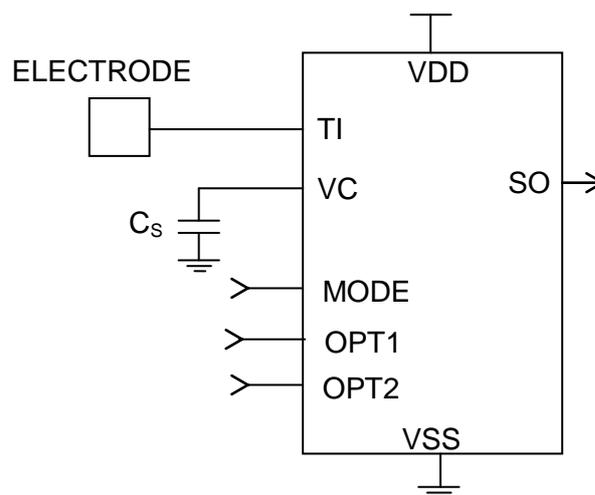
Ⅱ. Output mode（**By MODE pin selection**）

MODE pin:　　LED lightness regulation selection or 1 key Touch Pad Detector

MODE Pin	Share pin	Function　description
1 (Default)	OPT1	DC LED lightness regulation output selection.
	OPT2	Continuously or three steps lightness regulation selection.
0	TOGB	Detect direct output or toggle output selection.
	AHLB	Detect output active high or active low selection.

Ⅲ. Function table

Table (1): MODE =1(Default), DC LED lightness regulation selection

OPT1	OPT2	Function description	Note
1	1	Continuously lightness regulation without lightness-memory	Default
0	1	Continuously lightness regulation with lightness-memory	
1	0	Three-sections:　　[High → Middle → Low→Off] loop	
0	0	Three-sections:　　[Low → Middle → High rule →off] loop	

PS: OPT1,OPT2 within pull-high resister, float select "1" , if select "0" must be connected to GND。

Table (2): MODE = 0, 1 Key touch pad detector selection

TOGB	AHLB	Function description	Note
1	1	Direct output, CMOS active low	Default
1	0	Direct output, CMOS active high	
0	1	Toggle output, power on state = 1	
0	0	Toggle output, power on state = 0	

PS: TOGB, AHLB within pull-high resister, float select "1" , if select "0" must be connected to GND。

Ⅳ. MODE=1(Default), DC LED lightness regulation

The TTP118-AO8 is standby mode, it will be saving power. When detecting key touch, it will switch to detective mode. Until the key touch is released and will keep a time about 4 sec. Then it returns to standby mode. At standby mode SO output response time about 96ms. At detective mode SO output response time about 48 milliseconds.

1.DC LED lightness regulation touch key and SO output timing description:
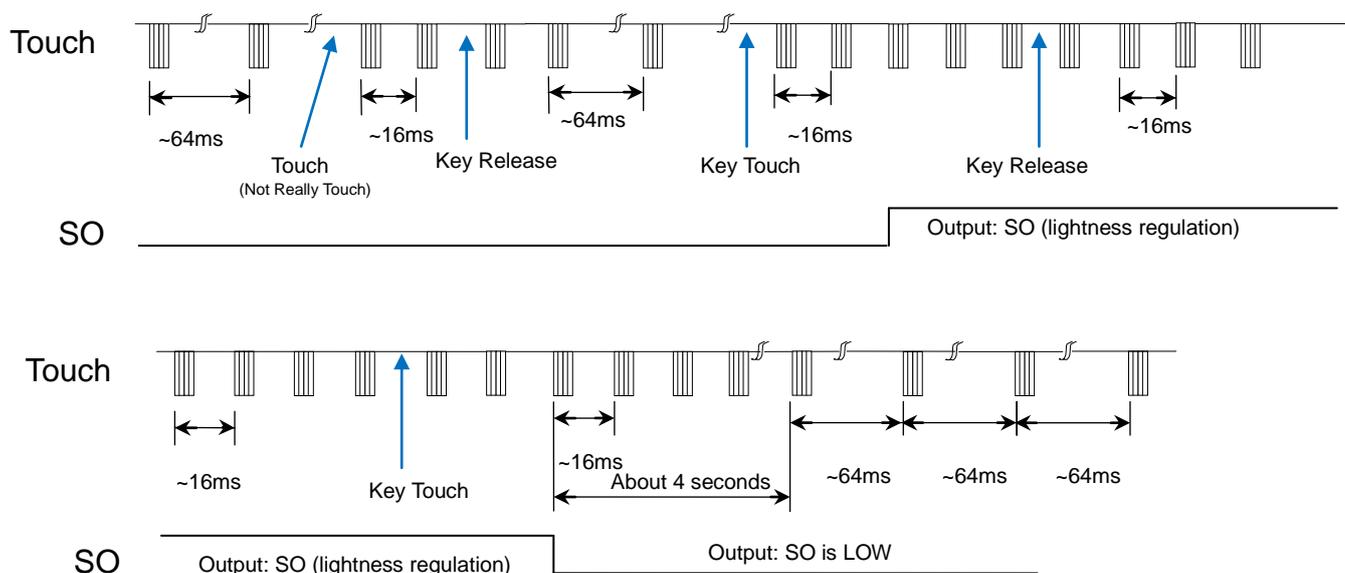
2.OPT1=1、OPT2=1(Default): Continuously lightness regulation without lightness-memory

  2-1.The Light holds off state when the circuit electrified initially.

  2-2.The touch operation with the duration less than 550ms could regulate the on-off state of the light. One touch operation turns the light on and one more operation turns it off. There is no lightness buffer when LED switches between on and off state, and the initial lightness is 90% of the max lightness.

  2-3.A long-playing touch operation with a duration more than 550ms could regulate the lightness continuous range. A long-playing touch operation makes the lightness increase continuously and when the touch operation ends the lightness decrease continuously and when the touch operation ends the lightness is also on the current level. If the duration of the touch operation is more than 3 seconds, the lightness will be lowest. The lightness PWM duty cycle minimum is 2%, the maximum is 100%.

  2-4.Anytime for users could switch between common touch operation and long-playing touch operation, and either function will not be influence by on another. The first touch operation in the state where the light is off, the light gradually decreases from 90%(PWM duty cycle).

3.OPT1=0、OPT2=1(Default): Continuously lightness regulation with lightness-memory

  3-1.This function does not have lightness memory without lightness buffer, regulating memory function based on regulating function. This is, in the case of continuous power supply, the lightness will be remembered each time the touch is turned off, and the lightness will be used as the initial lightness when the next touch is turned on.

  3-2.In the case of power off, the lightness memory function is invalid.

  3-3.The direction of the first dimming after turning on the light is determined by the lightness value of the previous memory. If the memory lightness value is greater than 50%, dim down, if the memory lightness value is less than 50%, dim up. After initial power-on or power-off, re-power on, the initial lightness of the first turn-on is fixed at 90% maximum lightness, the direction of first dimming is fixed to dim down.

4.OPT1=1(Default)、OPT2=0: LED lightness is regulated three-step adjustment [High →Middle →Low →OFF] loop.

  4-1.At initial power-on, SO output is low and the LED is not light.

  4-2.The first touch, the light is high-grade lightness; the second touch, the light is mid-range lightness; the third touch, the light is low-grade lightness; the fourth touch, the light is off. Playing touch multiple times, and the loop back. The third-order lightness corresponds to the output PWM signal duty cycle are 100%(High), 40%(Middle), 10%(Low).

5.OPT1=0、OPT2=0: LED lightness is regulated three-step adjustment
 [Low →Middle →High →OFF] loop.

5-1.At initial power-on, SO output is low and the LED are not light.

5-2.The first touch, the light is low-grade lightness; the second touch, the light is mid-range lightness; the third touch, the light is high-grade lightness; the fourth touch, the light is off. Playing touch multiple times, and the loop back. The third-order lightness corresponds to the output PWM signal duty cycle are 10%(Low), 40%(Middle), 100%(High).

Ⅴ.MODE = 0, Single key Touch Pad Detector

The TTP118-AO8 is standby mode, it will be saving power. When detecting key touch, it will switch to detective mode. Until the key touch is released and will keep a time about 4 sec. Then it returns to standby mode. At standby mode SO output response time about 132 milliseconds. At detective mode SO output response time about 48 milliseconds.

1. Direct output mode timing:
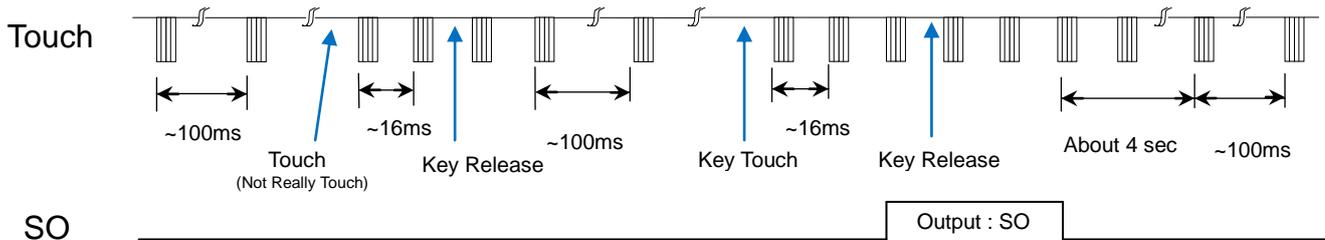
2. Single key Touch Pad Detector Direct output

2-1.TOGB=1(Default)、AHLB=1(Default): CMOS output active low.
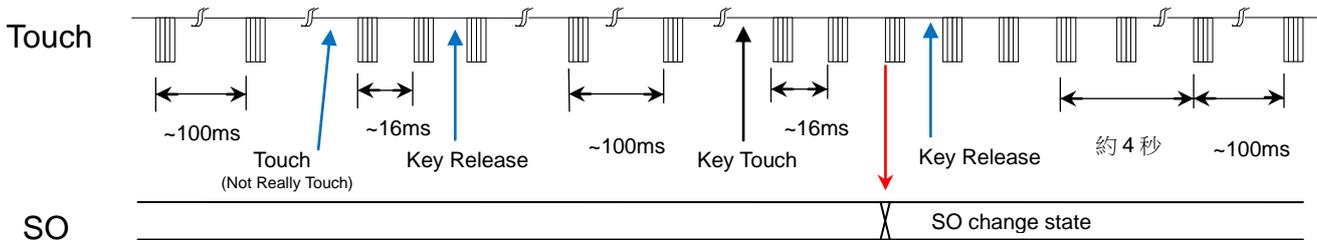   After initial power on SO output is high.
   Touch electrode SO output is low.

2-2. TOGB=1(Default)、AHLB=0 : CMOS output active high.
   After initial power on SO output is low.
   Touch electrode SO output is high.

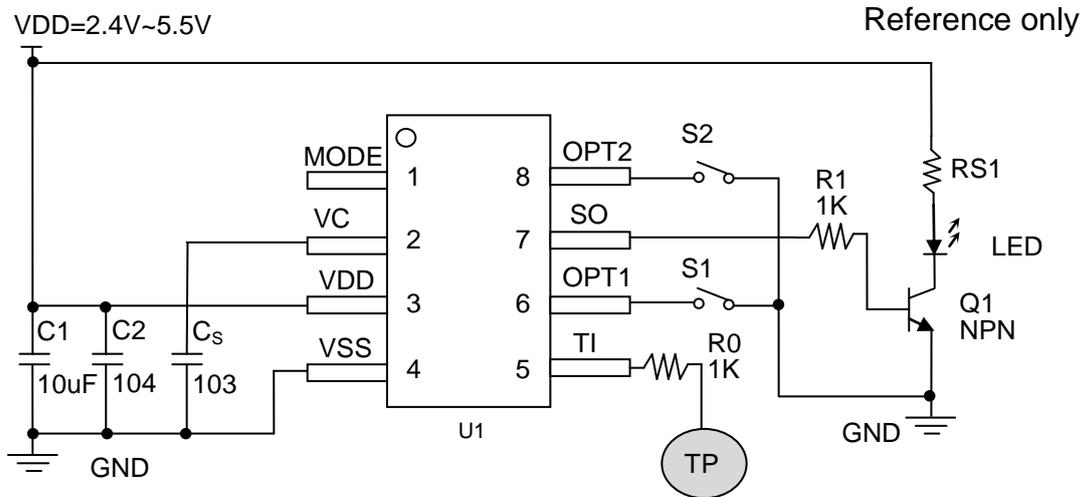3. Toggle mode timing:

3-1.TOGB = 0、AHLB = 1(Default)
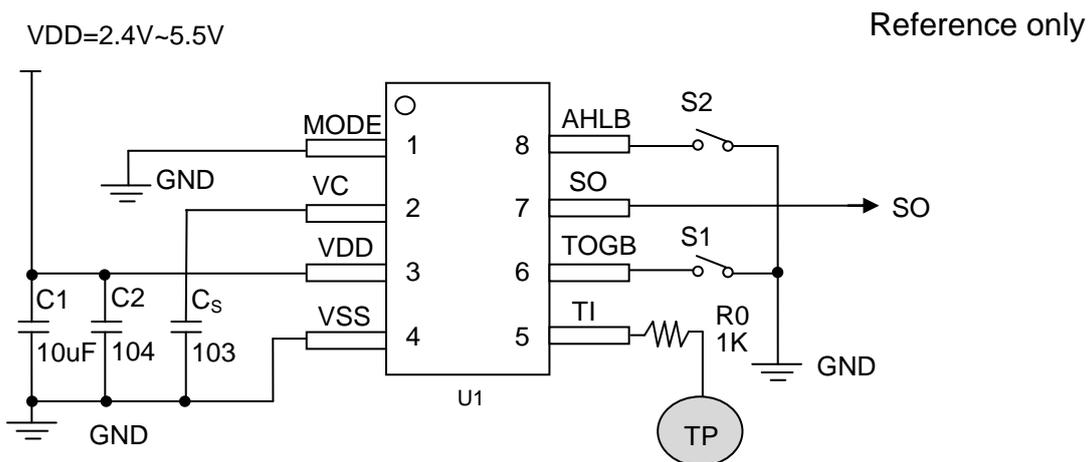   Toggle output, power on state =1.
   The SO output state is flipped once each time the electrode is touched.

3-2. TOGB = 0、AHLB = 0
   Toggle output, power on state =0.
   The SO output state is flipped once each time the electrode is touched.

Application circuit

1.MODE=1(Default), DC LED lightness regulation

2.MODE = 0, 1 key Touch Pad Detector

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 C2 capacitor must be used between VDD and VSS; and should be routed with very short tracks to the device's VDD and VSS pins.

5. The capacitance C_S can be used to adjust the sensitivity. The value of C_S use larger, then the sensitivity will be better. The sensitivity adjustment must according to the practical application on PCB. The range of C_S value are 1nF~47nF.

6. The sensitivity adjustment capacitors（C_S）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.

7. Medium type for adjustment capacitors（C_S）

C_S value Table

Medium Types	C_S Capacitance (Reference)
Acrylic sheet $\leqq$ 3mm	6.8nF/25V
3mm $\leqq$ Acrylic sheet $\leqq$ 6mm	10nF/25V
Acrylic sheet $\leqq$ 6-10mm	22nF/25V

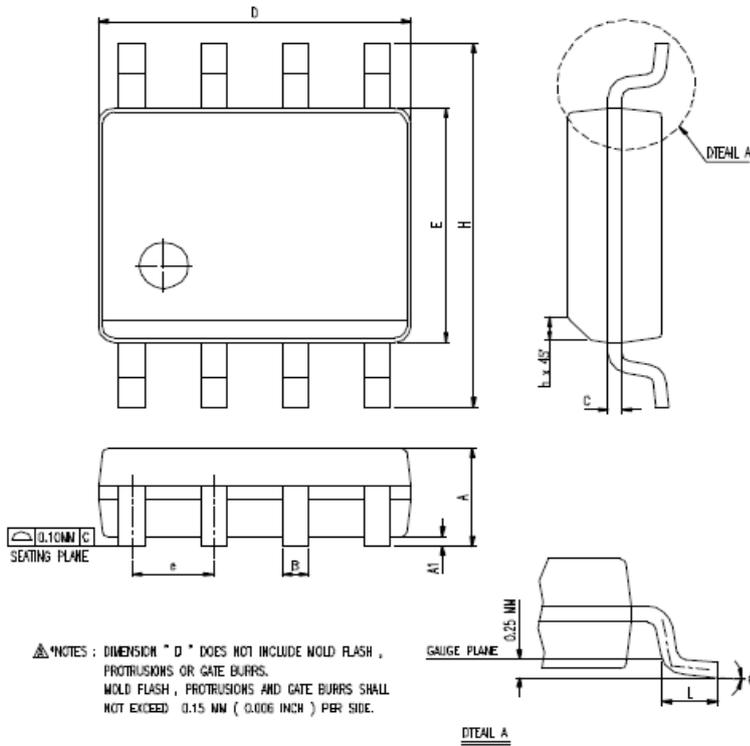**BOM table**

Symbol	Type	Element parameter
C1	Electrolytic capacitor	10uF/25V
C2	Ceramic capacitor	104
C_S	capacitor*	Reference **Cs value Table**
R0	Carbon film resister	1KΩ* reference application
R1	Carbon film resister	1KΩ* Current-limiting resister
RS1	Carbon film resister	Current-limiting resister*
Q1	NPN transistor	S8050
LED	Light-emitting diode	LED
S1,2	switch	Single pole single throw switch

PS: * Resistance value depends on the application.
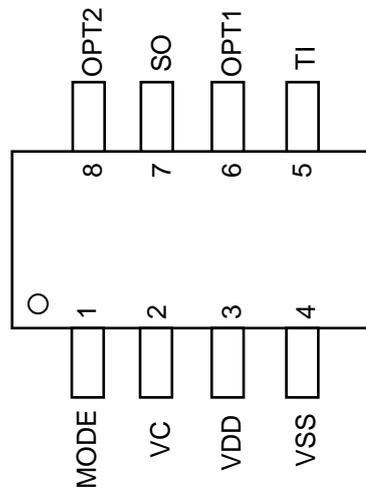
Package outline

Package Type: SOP-8

⚠️ *NOTES : DIMENSION " D " DOES NOT INCLUDE MOLD FLASH ,
PROTRUSIONS OR GATE BURRS.
MOLD FLASH , PROTRUSIONS AND GATE BURRS SHALL
NOT EXCEED 0.15 MM (0.006 INCH) PER SIDE.

SYMBOL	DIMENSION IN MM		DIMENSION IN INCH	
	MIN	MAX	MIN	MAX
A	1.35	1.75	0.0532	0.0688
A1	0.10	0.25	0.0040	0.0098
B	0.33	0.51	0.013	0.020
C	0.19	0.25	0.0075	0.0098
e	1.27 BSC		0.050 BSC	
D	4.80	5.00	0.1890	0.1968
H	5.80	6.20	0.2284	0.2440
E	3.80	4.00	0.1497	0.1574
L	0.40	1.27	0.016	0.050
h	0.25	0.50	0.0099	0.0196
θ	0°	8°	0°	8°

Package configuration

TTP118-AO8N

Package Type SOP-8

```
        OPT2  SO   OPT1  TI
         │    │    │    │
         8    7    6    5
    ┌─────────────────────────┐
    │                         │
    │  ○                      │
    │    1    2    3    4      │
    └─────────────────────────┘
         │    │    │    │
       MODE  VC   VDD  VSS
```


Ordering Information

TTP118		
Package Type	**Chip Type**	**Wafer Type**
TTP118-AO8N	No support	No support

REVISION HISTORY：

2019/04/10: Initial version V1.0