NEXT Lab

Semiconductor Development Group

NXM1001

High Sensitivity 1-CH
Capacitive Touch Switch

General Description

The NXM1001 is a auto calibration High sensitivity 1 channel Capacitive touch switch
It includes 2 oscillator and frequency shift detector.
It has very strong immunity against external noise or noisy environment with high performance Analog circuit and Adaptive Digital algorithm

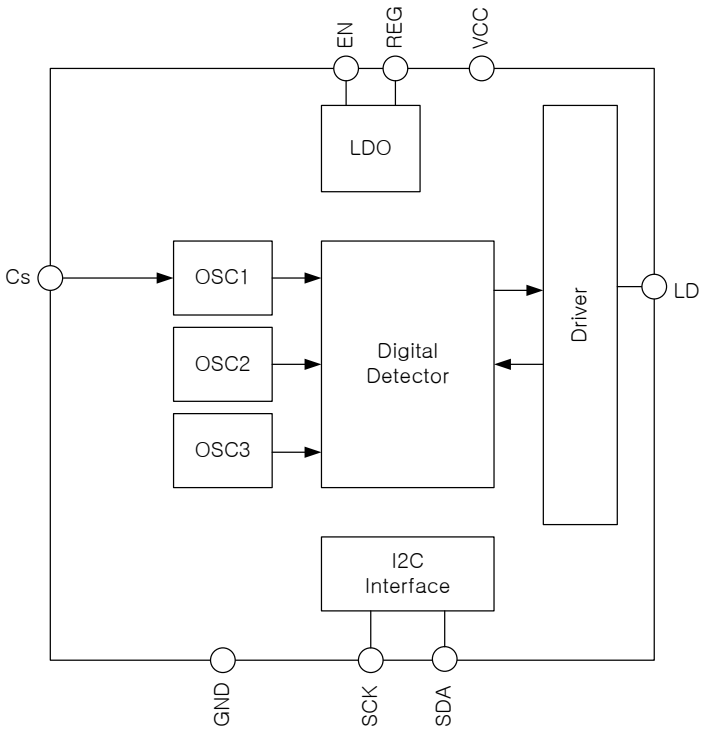
Feature

- Supply voltage : 1.6V ~ 3.6V
- Embedded Simple LDO
- Embedded POR and Enable External Reset control
- 4level LED Dimming
- Interface : IIC
- Enable Individual adjustment each channel sensitivity : 1of 8 Mode
- Very low frequency Harmonic Noise elimination
- Fixed frequency oscillation at any supply voltage
- Very low current consumption
- A few external parts
- Auto digital calibration
- Package : 8-SOP

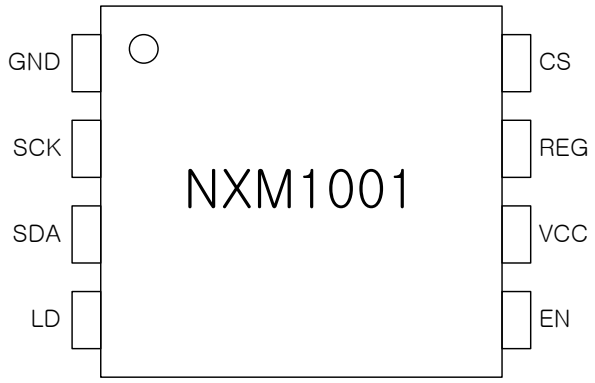
Application

- Mobile application
- Mini/Micro Audio system
- Membrane Switch replacement
- Sealed control panel
- Door key
- Flat TV

Block Diagram



Terminal assignment (8-SOP)



Pin description (6SOT)

Pin Name	Pin No.	I/O	Description
GND	1	S	Ground
SCK	2	I	I2C Interface Clock
SDA	3	I/O	I2C Interface Data
LD	4	O	Indication Output
EN	5	I	Enable (Sensitivity set input when stand alone)
VCC	6	S	Power Supply
REG	7	O	Regulator output
CS	8	I	Capacitor sensor input

Electro-static Discharge (ESD)

Pin	Mode	Value	Unit
Input pin	HBM	8000	V
	MM	500	V
Other pins	HBM	2000	V
	MM	200	V

Maximum Absolute ratings

Parameter	Symbol	Value	Unit
Supply Voltage	Vccmax	-0.3 ~ 3.6	V
Maximum Pin Voltage (Normal)	Vpnmax	-0.3 ~ Vdd+0.3	V
Maximum Pin Voltage (Open Collector)	Vpomax	-0.3 ~ 3.6	V
Storage temperature	Tstg	-45 ~ 150	℃
Operating temperature	Topr	-40 ~ 85	℃
Power Dissipation	Pdmax	800	mW

Electrical Characteristics

VCC = 3.3V, Ta=25.0℃ Unless otherwise noted

Characteristics	Symbo	Condition	Value			Unit
			min	typ	max	
Operating voltage range	VDD	-	1.6	-	3.6	V
Current Consumption	Idd	BF Mode	-	140	-	uA
		BS Mode	-	30	-	
Sense Oscillation Frequency	Fs	Any Vdd voltage	-	4.0	-	MHz
Open Collector output maximum sink current	Isink	Vout=0.4V Default setting	-	10	-	mA
Minimum Detective capacitance Difference	△C	-	-	-	0.01	pF
Self calibration time	Tcall	After system reset	-	25.6	-	ms
Burst Sense Oscillation Period	Tp	BF Mode	-	3.2	-	ms
		BS Mode	-	24.0	-	
Response Time 1	Tr1	BF Mode	-	12.8	-	ms
Response Time 2	Tr2	BS Mode	-	96.0	-	ms

Application Note

- Power Sequence

When NXM1001X is supplied with VCC initially, there is a possibility of malfunction because of unstable power supply (VCC). We recommend that you should reset NXM1001X after power on. You can make EN (PIN4) low to reset NXM1001X

- Sensitivity setting

NXM1001X detect external resister between VCC and EN, when power on.

And according to the resister value, capacitance detect sensitivity is determined.

See below table.

Resister Value	<10K	20K	30K	40K	50K	60K	70K	80K <
Sensitivity Level	1	2	3	4	5	6	7	8
Decription	← High Sensitivity							Low Sensitivity →

When Sensitivity level 4,

10mm*10mm Sense pad is detectable 5mm acrylic isolation.

- Internal detect mode (Frequency) setting

NXM1009X has 4 internal system frequency, f1, f2, f3 and f4. F4 is the fasted and F1 is the lowest. And the Internal detect mode (Frequency) is selectable by I2C Interface.

- Detect speed setting

NXM1009X has 3 Detect speed modes.
If FS mode, NXM1009X stay BS mode, and key detect, it is changed BF mode.
And SL mode, NXM1009 stay Sleep mode, and key detect, It is changed BF mode.
At any mode, if Key is detected within 4sec after last key released,
the mode is not changed.
In other word, after 4sec from Key released, it is return BS mode (when FS mode),
or Sleep mode (when SL mode)
If BF mode is selected by controller, the NXM1009 operates BF mode always

※ There are 3 mode of operation with the current consumption.
FF mode operates always on the BF mode. Although It consumes current much, key detection time is the shortest.
FS mode operates normally on the BS mode. After detecting key, operation mode is converted to the BF mode. Current consumption is smaller the FF mode.
SL mode operates normally Sleep mode. After detecting key, operation mode is converted to the BF mode. Current consumption is the smallest.
There are 3 mode of key scan mode, key scan period is different each other(refer 3p)

* Register Map

Sub address	Data [7:0]								
0X00						DRTmd	OPRmd[1:0]		
0X01						ILED[2:0]			
0X02					OSCmd[1:0]				
0X03		Sensitivity [2:0]							
0X10						SRst			

* DRTmd & OPRmd[1:0] : Operating mode

DRTmd	OPRmd1	OPRmd0	Operation
0	0	0	BF mode always
0	0	1	FS mode (BS ←→ BF)
0	1	0	SL mode (Sleep ←→ BF)
0	1	1	NU
1	0	0	BF mode always
1	0	1	BS mode always
1	1	0	Sleep mode always
1	1	1	NU

* ILED[2:0] : LED Dimming

ILEDX	ILEDX	ILEDX	Operation
0	0	0	ILED = Level 0
0	0	1	ILED = Level 1
0	1	1	ILED = Level 2
1	1	1	ILED = Level 3

* OSCmd[1:0] : Detect mode (Frequency) setting

OSCmd1	OSCmd0	Operation
0	0	about fixed f3
0	1	about fixed f4
1	0	Reserved
1	1	Reserved

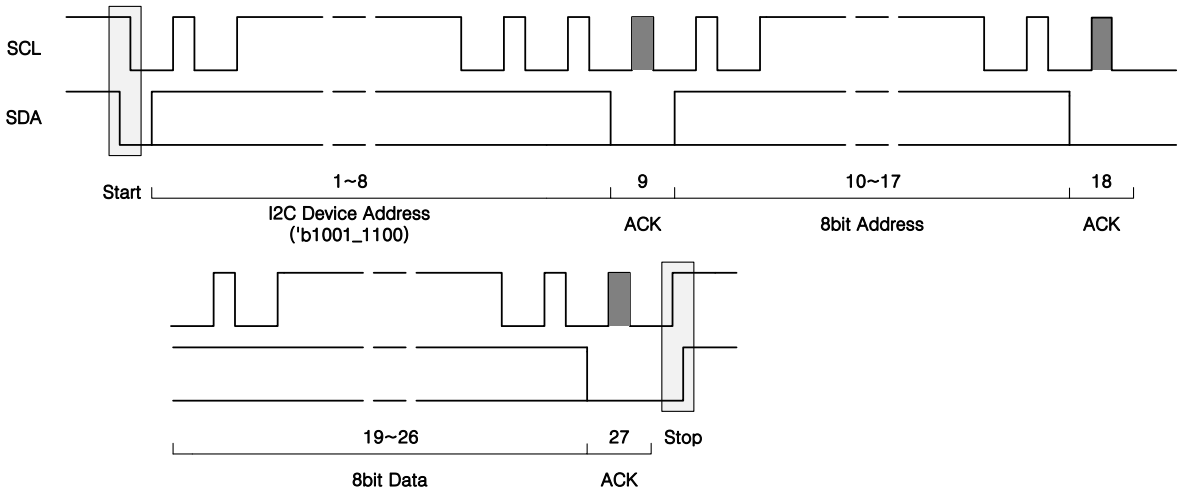
* Sensitivity [2:0] : Each channel sensitivity setting

D2	D1	D0	Sensitivity	Operation
0	0	0	Level 1	High Sensitivity
0	0	1	Level 2	
0	1	0	Level 3	
0	1	1	Level 4	Detectable 10mm*10mm PAD in 5mm acrylic isolation.
1	0	0	Level 5	
1	0	1	Level 6	
1	1	0	Level 7	
1	1	1	Level 8	Low sensitivity

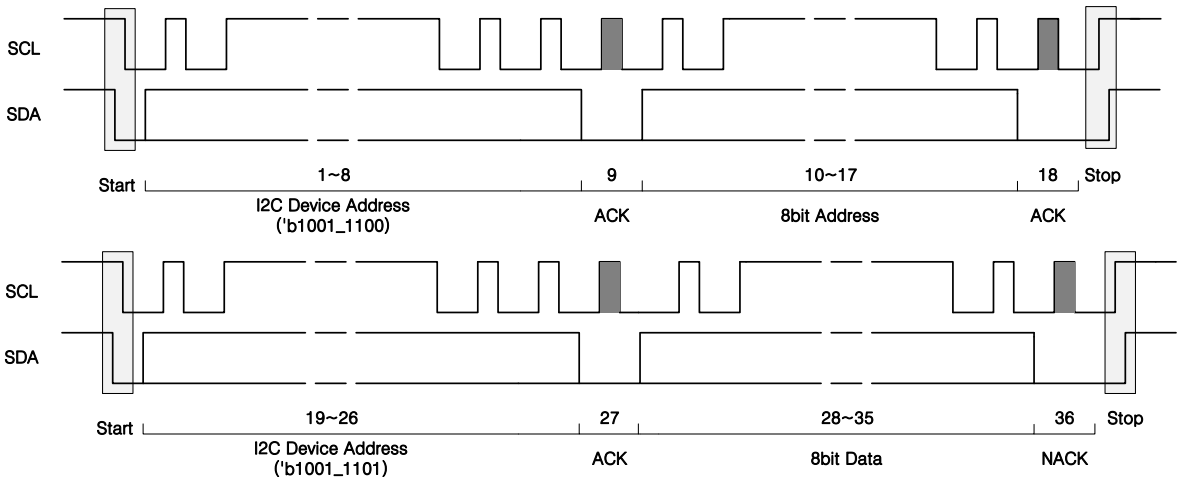
* SRst : Soft Reset

Value	Operation
0	Normal status
1	Soft Reset status

* Write Register Data through I2c Interface



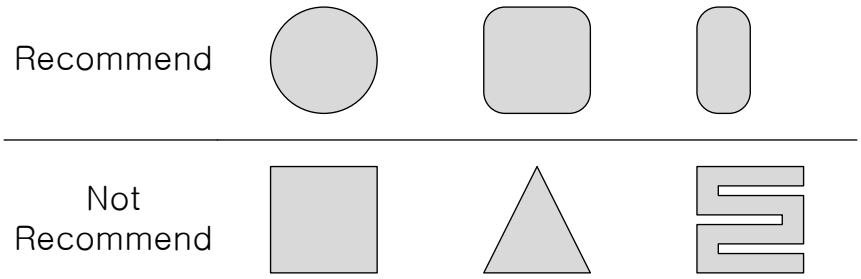
* Read Register Data through I2c Interface



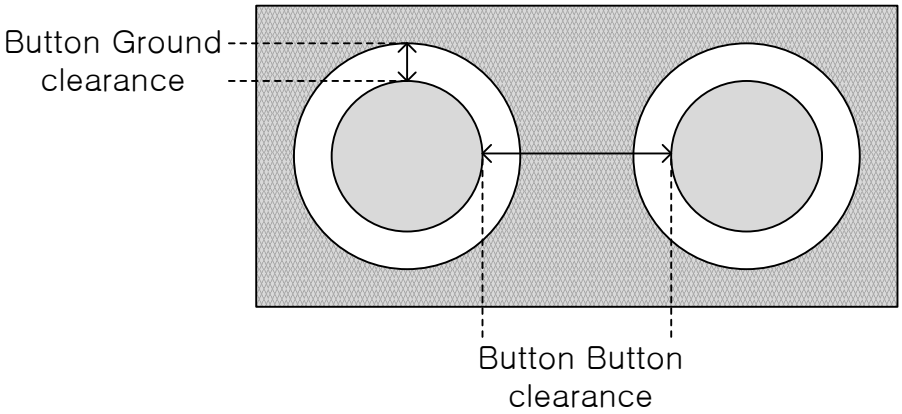
Layout Guidelines and best Practices

Sl. No.	Category	Min	Max	Recommendations / Remarks
1	Button Shape			Solid round pattern, Round with LED hole, rectangle with round corners
2	Button Size	2mm	20mm	Recommend : Minimum = 5mm
3	Button-Button spacing	0.1mm		Recommend : Minimum = 0.5mm
4	Button Ground Clearance	0.1mm	2mm	Recommend : Minimum = 0.5mm
5	Ground flood – top layer			Hatched ground 7 mil trace and 45 mill grid (15% filling)
6	Ground flood – bottom layer			Hatched ground 7 mil trace and 70 mil grid (10% filling)
7	Trace Length from Sensor pad to device pin			The length should be short as possible. Recommend : Length < 10cm
8	Trace Width	0.17mm	0.2mm	
9	Trace Routing			Traces should be routed on the non button side. If any non CapSense trace crosses CapSense trace, ensure that intersection is orthogonal.
10	Via Position for the sensors			Via should be placed near the edge of the button pad to reduce trace length thereby increasing sensitivity.
11	Via Hole Size for sensor traces			10 mil
12	Number of via on sensor trace	1	2	1
13	Cap Sense series resistor placement		10mm	Place Cap Sense series resistors close to the device for noise suppression. Cap sense resistors have highest priority, place them first.
14	Distance between Any Cap Sense trace to Ground	10mil	20mil	20mil
15	Device placement			Mount the Device on the layer opposite to button. The Cap Sense trace length between the Device and buttons should be minimum

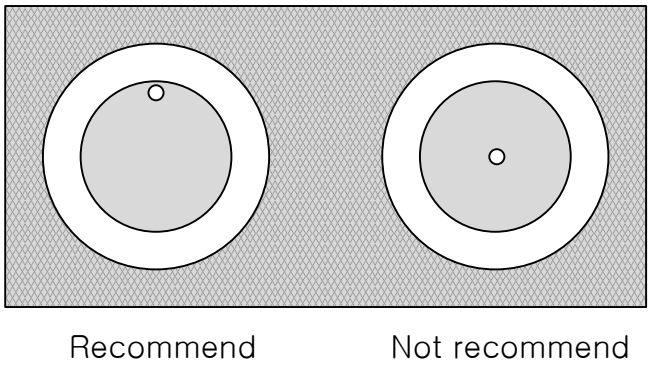
CapSence Button shapes



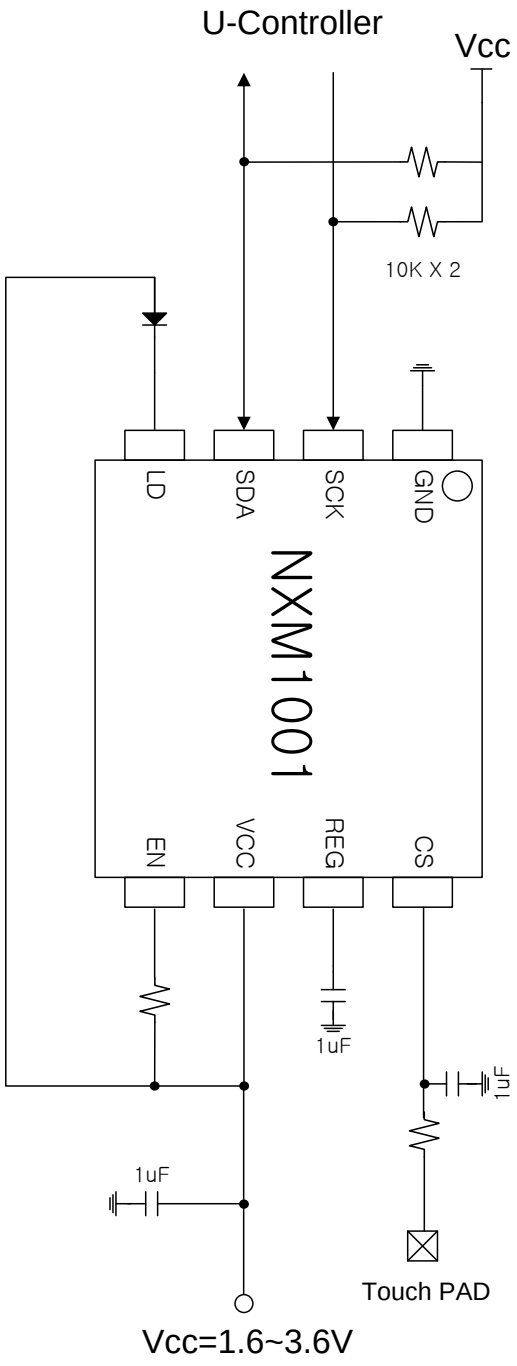
Button Layout Design



Recommended via-hole Placement



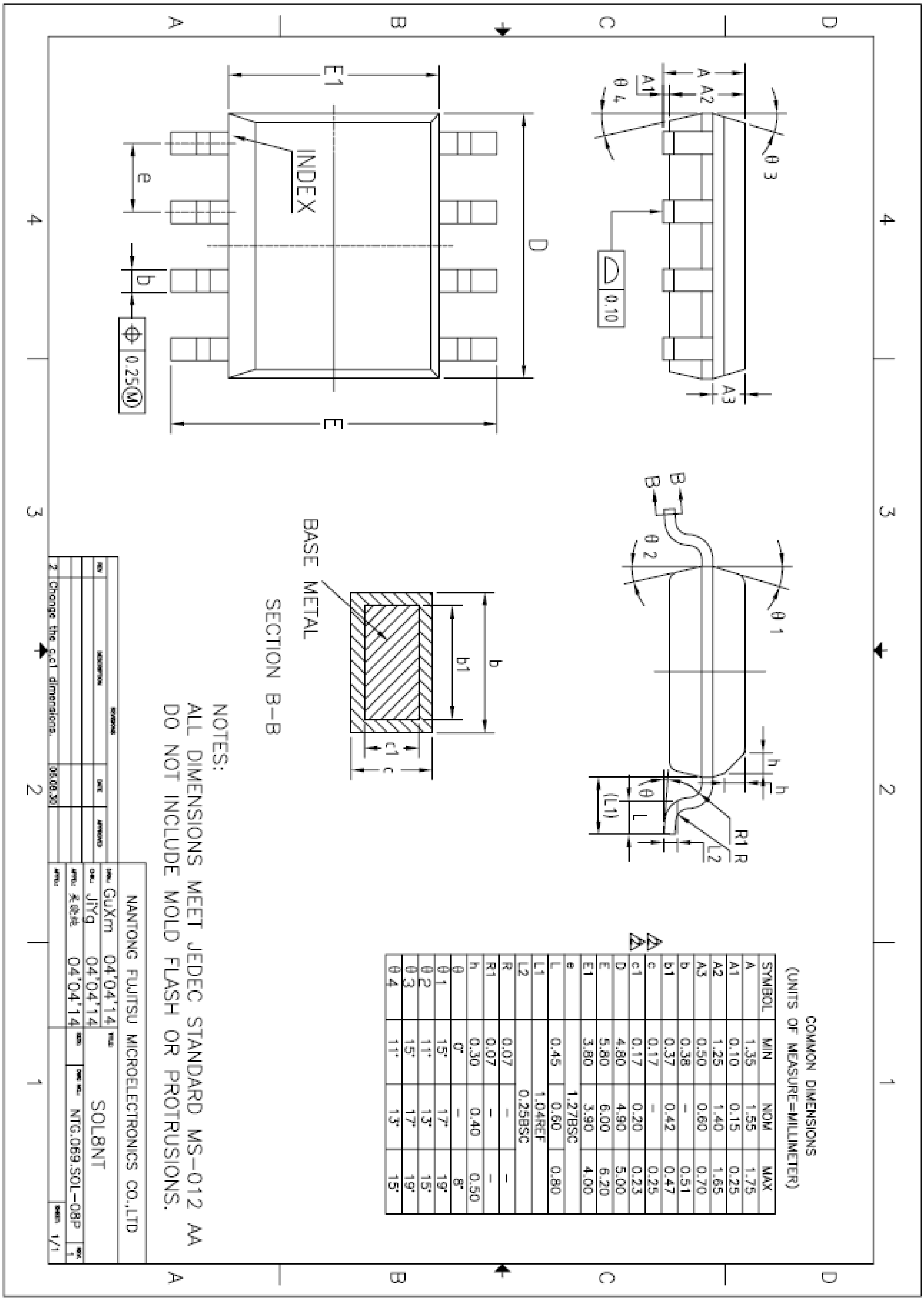
Application Circuit



※ We recommend CS`s Resistor is from 1.6k to 2.4k and Capacitor is less than 5pF.

※ CS`s Resistor and Capacitor are not affected by noise, as closer to the chip.

Package Outline (8SOP)



SYMBOL	MIN	NOM	MAX
A	1.35	1.55	1.75
A1	0.10	0.15	0.25
A2	1.25	1.40	1.65
A3	0.50	0.60	0.70
b	0.38	–	0.51
b1	0.37	0.42	0.47
c	0.17	–	0.25
c1	0.17	0.20	0.23
D	4.80	4.90	5.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e		1.27BSC	
L	0.45	0.60	0.80
L1		1.04REF	
L2		0.25BSC	
R	0.07	–	–
R1	0.07	–	–
h	0.30	0.40	0.50
θ	0°	–	8°
θ1	15°	17°	19°
θ2	11°	13°	15°
θ3	15°	17°	19°
θ4	11°	13°	15°