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## Capacitive Sensor Control IC Series

# Capacitive Sensor Switch Control IC


**BU21051FS**

No.09048EBT05

**●Description**

BU21051FS are the capacitive sensor controller with 2ch respectively.  
The IC has the port interface and easy to replace the point of switch to this controller.

**●Features**

- 1) Port output interface
- 2) Few software control
- 3) 2ch GPIO outputs
- 4) 5V power supply voltage available
- 5) Integrated 10bit AD converter, clock and reset
- 6) Package SSOP-A16

**●Applications**

It is possible to use it widely as a switch such as home electric appliance.

**●Absolute Maximum Ratings (Ta=25°C)**

PARAMETER	SYMBOL	RATING		UNIT
		MIN	MAX	
Applied voltage	AVDD	-0.3	7.0	V
	DVDD	-0.3	7.0	
Input voltage	VAIN	-0.3	AVDD + 0.3	V
	VDIN	-0.3	DVDD + 0.3	
Storage temperature range	T <sub>stg</sub>	-55	125	°C
Power dissipation	P <sub>d</sub>	500		mW

Ambient temperature reduces a permission loss by 5mW per case more than 25 degrees Celsius, 1 degree Celsius

**●Recommended Operating conditions**

PARAMETER	SYMBOL	RATING			UNIT
		MIN	TYP	MAX	
Applied voltage	AVDD	4.5	5.0	5.5	V
	DVDD	4.5	5.0	5.5	
Operating temperature range	T <sub>opr</sub>	-40	25	85	°C

●Electrical characteristics(Especially, Topr=25°C and AVDD=DVDD=0 as long as it doesn't specify it.)

PARAMETER	SYMBOL	RATING			UNIT	Condition
		MIN	TYP	MAX		
DC characteristics						
Input“H”voltage	V <sub>IHI0</sub>	DVDD x 0.9	-	DVDD + 0.2	V	
Input“L”voltage	V <sub>ILIO</sub>	GND - 0.2	-	DVDD x 0.1	V	
Output“H”voltage	V <sub>OL</sub>	GND	-	DVDD x 0.2	V	I <sub>OH</sub> = -2[mA]. Overshoot is excluded.
Output“L”voltage	I <sub>Iz</sub>	-1	-	1	μA	
Input leakage current	I <sub>OZ</sub>	-1	-	1	μA	
Output leakage current	I <sub>ST</sub>	-	-	2	μA	Shutdown (SDN=“L”)
Standby current	I <sub>DD</sub>	-	500	-	uA	

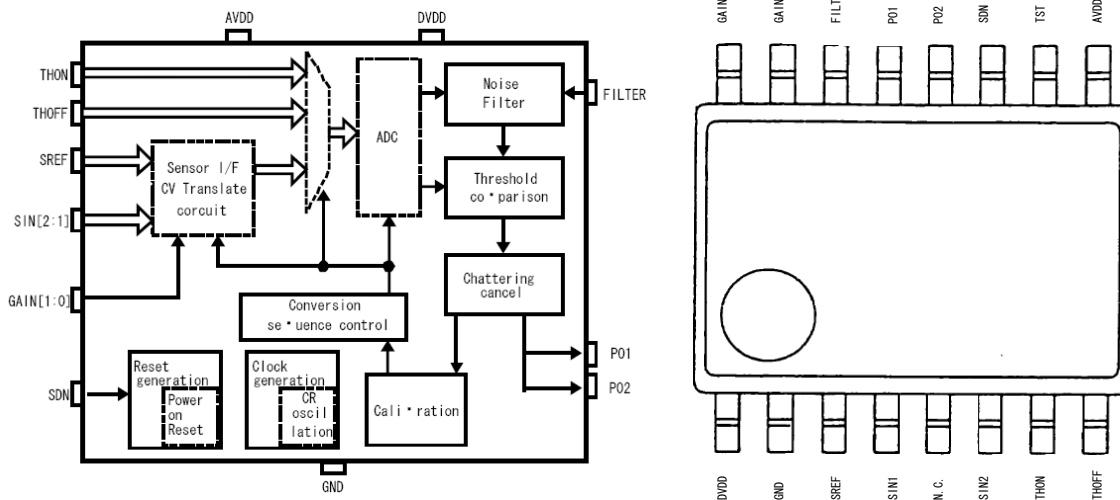
●A/D Converter

PARAMETER	SYMBOL	RATING			UNIT	Condition
		MIN	TYP	MAX		
Resolution		-	10	-	bit	
Analog Input voltage	V <sub>AIN</sub>	GND	-	AVDD	V	
Change clock frequency	f <sub>adck</sub>	0.2	-	1.0	MHz	
Change time	t <sub>tim</sub>	-	13	-	μsec	f <sub>adck</sub> = 1[MHz]
Zero scale voltage		-	-	GND + 0.07	V	
Full scale voltage		AVDD - 0.07	-	-	V	
Differential non line accurate	DNL	-	-	±3	LSB	
Integrate non line accurate	INL	-	-	±3	LSB	

●CR Oscillator characteristic

PARAMETER	SYMBOL	RATING			UNIT	Condition
		MIN	TYP	MAX		
Oscillation Frequency	f <sub>cr</sub>	0.9	1.6	2.5	MHz	

●Block Diagram, Pin configuration



●Sensor I/F CV Conversion Circuit:

This part selects target sensor and converts its capacitance to a voltage signal. Specifically, alleight sensors are selected one-by-one and their capacity is compared to a common referencecapacity. Each difference value is converted to a certain voltage signal.

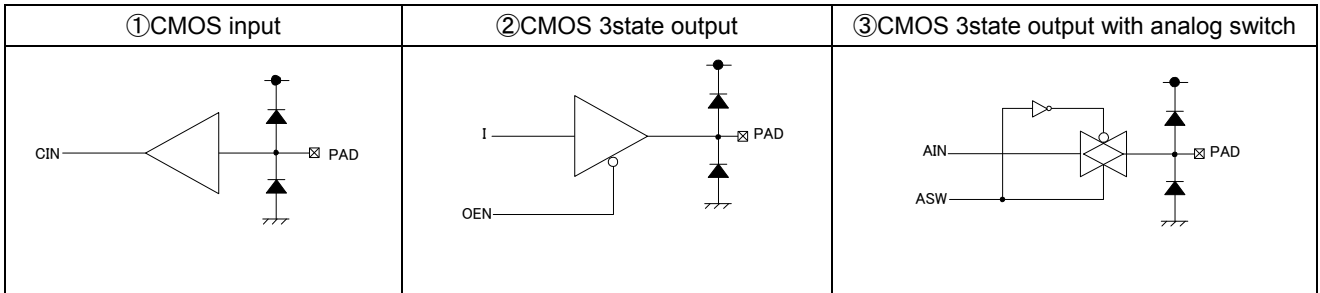
- AD Conversion  
The voltage signal derived from CV conversion is further converted to digital value by this block.
- Conversion Sequence Control  
This block controls the process of CV conversion and generates timing of selecting target sensors.
- Noise Filter  
The GND level difference between appliance and human body will cause noises to the CV conversion
- Compare threshold  
CV converted to sensor data On / Off compared with a threshold, the switch converts the signal.
- Calibration  
When the capacitance change do not exceed the threshold for a certain period, this blockstarts-up calibration process.
- Reset Generation  
This is internal reset circuit. Reset is initialized by external SDN signal.
- Clock Generation  
Clock from internal RC oscillation circuit is used as system clock.

● Pin Description

Pin No	Name	I/O	Function	Notes	Supply reference	Reset level <sup>※1</sup>	I/O Pad
1	DVDD	Power	Digital part Power supply	Digital part Power supply	-		
2	GND	Ground	Ground	-	-		
3	SREF	AIn	Standard capacitor input	-	AVDD	“Hi-Z”	③
4	SIN1	AIn	Sensor input1	-	AVDD	“Hi-Z”	③
5	N.C.	-	No connect	-	-	-	-
6	SIN2	AIn	Sensor input 2	-	AVDD	“Hi-Z”	③
7	THON	AIn	Sensor ON threshold voltage input	-	AVDD	“Hi-Z”	③
8	THOFF	AIn	Sensor OFF threshold voltage input	-	AVDD	“Hi-Z”	③
9	AVDD	Power	Analog part Power supply	-	-		
10	TST	In	Test input	Usually tide to “L”	DVDD	-	①
11	SDN	In	Shutdown input	“H” : state of operation “L” : halt condition	DVDD		①
12	PO2	Out	Switch output 2	Sensor pin2 On → “L”, Off → “Hi-Z”	DVDD	“Hi-Z”	②
13	PO1	Out	Switch output 1	Sensor pin1 On → “L”, Off → “Hi-Z”	DVDD	“Hi-Z”	②
14	FILTER	In	Filter selection	“H”: Filter effect: strong “L”: Filter effect: Weak	DVDD		①
15	GAIN[0]	In	Gain level selection	GAIN[1:0] = 00 : Strong GAIN[1:0] = 01 : ↑ Gain GAIN[1:0] = 10 : GAIN[1:0] = 11 : Weak	DVDD		①
16	GAIN[1]	In			DVDD		①

※\*1 Initial State ① When internal organs power-on reset is effective  
② When SDN = “L”

● I/O Circuit



**【THON: Button OFF→ON threshold value judge】**

**【THOFF: Button ON→OFF threshold value judge】**

Setting the threshold value of electrostatic Sensor Switches. By applying voltages can be set.  
As an example, 1/2VDD applied to the entire range of the sensor output 1 / 2 to set the threshold value.  
In fact, the voltage setting resistance to the partial pressure is recommended to us.

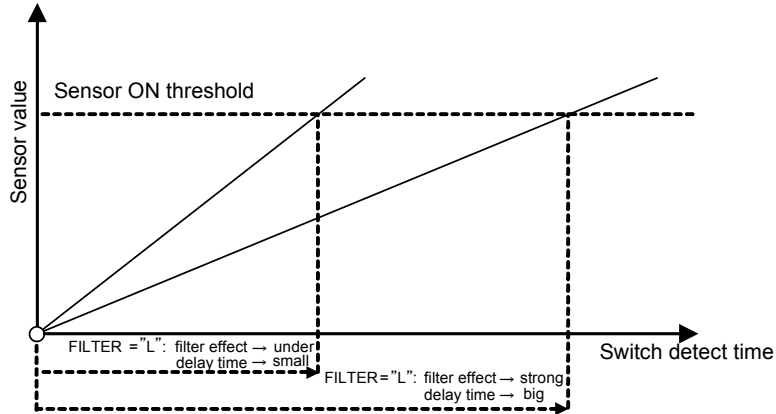
**【GAIN Selection】**

Sensor gain can be set in 4 stages

- GAIN[1:0] = 00 (x92)
- GAIN[1:0] = 01 (x69)
- GAIN[1:0] = 10 (x46)
- GAIN[1:0] = 11 (x1)

**【Filter selection】**

The noise filter effect can be selected. If "Strong" is selected, noise will get down, but the reaction time will be longer.

**●Setting method**

- 1) Please for the first time in a minimum gain.
- 2) THOFF = 0V, and, THON 1/2VDD voltage as a guideline for whether or not to switch ON, and gain selection to please the rough.

Note: ON gain to a minimum, you gain more precision amended to increase the impact too, so please take note.

**●Operation Mode**

This IC has several modes, called detection mode, calibration mode, and shut-down mode. Each mode is described as follow

**【Detection Mode】**

This is normal operation mode of this IC. In this mode, IC detects the sensor capacitance continually.

**【Calibration Mode】**

Under detection mode when no operation has been detected for sometime, Sensor offset calibration will be done. And the interval between each calibration is fixed

Detection mode and Calibration mode are switched automatically.

**【Shutdown Mode】**

When SDN pin is set to "L", IC will be shut-down and all internal circuits will stop working. IC will work again when SDN pin is set to "H".

**●Power Supply ON Sequence**

This IC has two power input pins AVDD and DVDD. Power ON sequence must be whether set DVDD first or set the two at one time. Since internal reset circuit is monitoring AVDD, wrong power ON sequence may cause initialization error.

●Ordering number

B	U
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Part No

2	1	0	5	1
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Part No

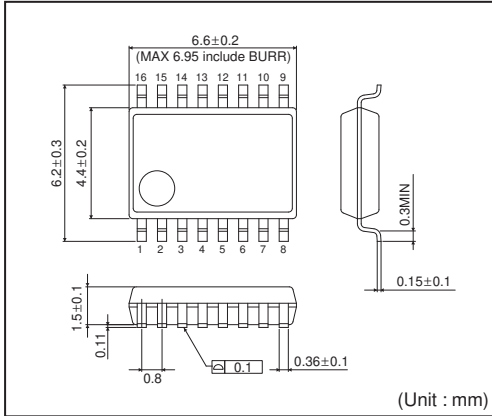
F	S
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Package  
FS : SSOP-A16

E	2
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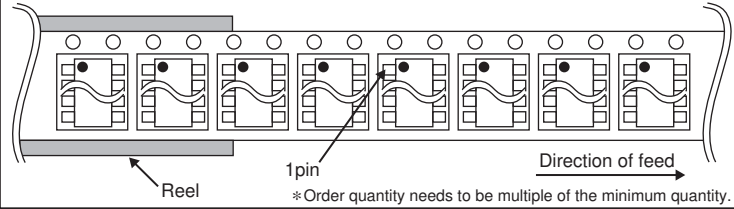
Packaging and forming specification  
E2 : Embossed tape and reel

SSOP-A16



<Tape and Reel information>

Tape	Embossed carrier tape
Quantity	2500pcs
Direction of feed	E2 ( The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand )



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