

## Capacitive Sensor Control IC Series

# Capacitive Sensor Switch Control IC

**BU21050FS**


No.09048EBT01

**●Description**

BU21050FS are the capacitive sensor controller with 8ch 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) 4bit Binary outputs or 8GPIO outputs
- 4) 5V power supply voltage available
- 5) Integrated 10bit AD converter, clock and reset
- 6) Package SSOP-A32

**●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>	760		mW

Ambient temperature reduces a permission loss by 7.6mW 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.)

Item	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>ILI0</sub>	GND - 0.2	-	DVDD x 0.1	V	
Output“H”voltage	V <sub>OHI0</sub>	DVDD x 0.8	-	DVDD	V	I <sub>OH</sub> = -2[mA].Overshoot is excluded.
Output“L”voltage	V <sub>OL</sub>	GND	-	DVDD x 0.2	V	I <sub>OL</sub> = 2[mA].Undershoot is excluded.
Input leakage current	I <sub>Iz</sub>	-1	-	1	μA	
Output leakage current	I <sub>Oz</sub>	-	-	1	μA	
Standby current	I <sub>ST</sub>	-	-	2	μA	Shutdown (SDN=“L”)
Operation current	I <sub>DD</sub>	-	550	-	uA	

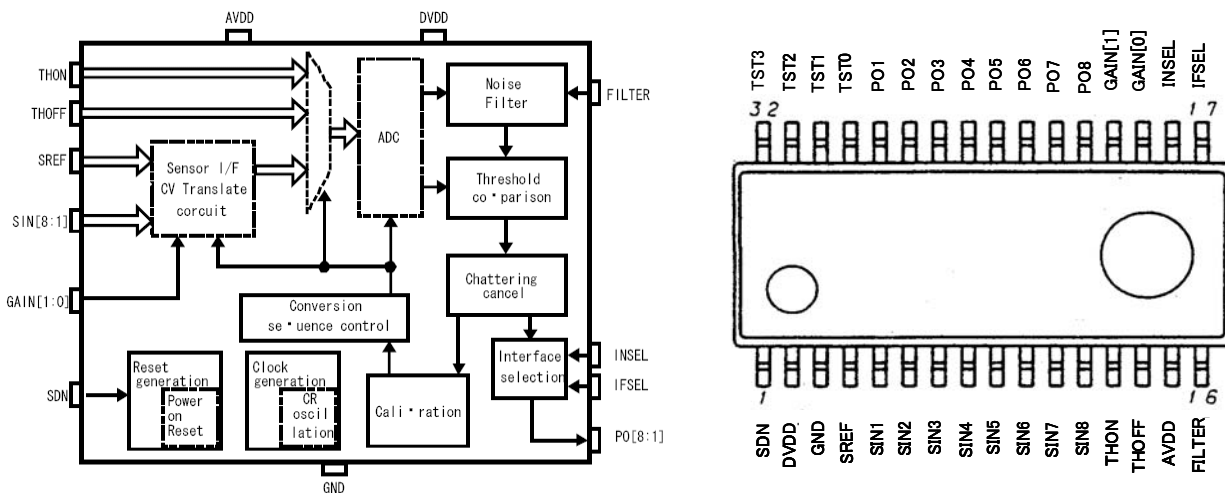
●A/D Converter

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	-	2.0	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		
Frequency Oscillation	f <sub>cr</sub>	0.8	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, all eight sensors are selected one-by-one and their capacity is compared to a common reference capacity. 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 circuit. This block eliminates these noises.
- **Compare threshold**  
CV converted to sensor data On / Off compared with a threshold, the switch converts the signal.
- **Interface Selection**  
By setting this block, output mode can be set to either 8-bit PIO mode or 4-bit binary mode.
- **Calibration**  
When the capacitance change do not exceed the threshold for a certain period, this block starts-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	Note	Supply	Reset Level	I/O Pad
1	SDN	In	Shutdown input	"H" : state of operation "L" : halt condition	DVDD		①
2	DVDD	Power	Digital part Power supply	Digital part Power supply	-		
3	GND	Ground	Ground	-	-		
4	SREF	AI <sub>n</sub>	Standard capacitor input	-	AVDD	"Hi-Z"	③
5	SIN1	AI <sub>n</sub>	Sensor input1	-	AVDD	"Hi-Z"	③
6	SIN2	AI <sub>n</sub>	Sensor input 2	-	AVDD	"Hi-Z"	③
7	SIN3	AI <sub>n</sub>	Sensor input 3	-	AVDD	"Hi-Z"	③
8	SIN4	AI <sub>n</sub>	Sensor input 4	-	AVDD	"Hi-Z"	③
9	SIN5	AI <sub>n</sub>	Sensor input 5	-	AVDD	"Hi-Z"	③
10	SIN6	AI <sub>n</sub>	Sensor input 6	-	AVDD	"Hi-Z"	③
11	SIN7	AI <sub>n</sub>	Sensor input 7	-	AVDD	"Hi-Z"	③
12	SIN8	AI <sub>n</sub>	Sensor input 8	-	AVDD	"Hi-Z"	③
13	THON	AI <sub>n</sub>	Sensor ON threshold voltage input	-	AVDD	"Hi-Z"	③
14	THOFF	AI <sub>n</sub>	Sensor OFF threshold voltage input	-	AVDD	"Hi-Z"	③
15	AVDD	Power	Analog part Power supply	-	-		
16	FILTER	In	Filter selection	"H": Filter effect: strong "L": Filter effect: Weak	DVDD		①
17	IFSEL	In	Sensor output selection	"H" :ON : L-Active, OFF : Nch Open Drain "L" : 4bit Binary Mode H-Active, L	DVDD		①
18	INSEL	In	simultaneous push selection	"H" : simultaneous push banned "L" : 8 outputs setting	DVDD		①
19	GAIN[0]	In	Gain level selection	GAIN[1:0] = 00 : Strong GAIN[1:0] = 01 : ↑ Gain GAIN[1:0] = 10 : ↑ Gain GAIN[1:0] = 11 : Weak	DVDD		①
20	GAIN[1]	In			DVDD		①
21	PO8	Out	sensor output8	-	DVDD	"Hi-Z" <sup>※2</sup> "L" <sup>※3</sup>	②
22	PO7	Out	sensor output7	-	DVDD	"Hi-Z" "L"	②
23	PO6	Out	sensor output6	-	DVDD	"Hi-Z" "L"	②
24	PO5	Out	sensor output5	-	DVDD	"Hi-Z" "L"	②
25	PO4	Out	sensor output4/BIN[3]	INSEL="L": Binary Mode 0000 = Button OFF 0001 = SIN1 ON 1000 = SIN8 ON	DVDD	"Hi-Z" "L"	②
26	PO3	Out	sensor output3/BIN[2]		DVDD	"Hi-Z" "L"	②
27	PO2	Out	sensor output2/BIN[1]		DVDD	"Hi-Z" "L"	②
28	PO1	Out	sensor output1/BIN[0]		DVDD	"Hi-Z" "L"	②
29	TST0	In	digital part test input0	Usually tide to "L"	DVDD		①
30	TST1	In	digital part test input1	Usually tide to "L"	DVDD		①
31	TST2	In	digital part test input2	Usually tide to "L"	DVDD		①
32	TST3	In	digital part test input3	Usually tide to "L"	DVDD		①

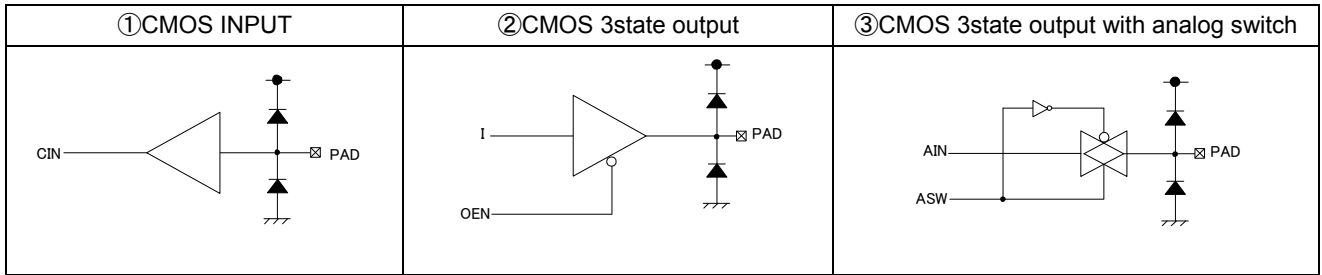
※\*1 Initial State ①When internal organs power-on reset is effective

②When SDN="L"

※2 "Hi-Z" when PIO Mode

※3 "L" when Binary Mode

● I/O Circuit



**【IFSEL: Output interface format】**

IFSEL	Mode	Output format
H	8ch PIO	L-active, Nch Open Drain
L	4bit Binary	H-active, L

INSEL = H : 8GPIOs output mode  
Initial status PO[8:1] = Hi-Z

INSEL = L : 4bit Binary output mode  
Initial Status PO[4:1] = L

Button	PO[4:1]
Button OFF	0000
SIN1	0001
SIN2	0010
SIN3	0011
SIN4	0100
SIN5	0101
SIN6	0110
SIN7	0111
SIN8	1000

Only the first sensor input was effective in terms of button ON judgment when more than one input has occurred.  
Next judgment would be done after all the button is OFF.

**【INSEL : Simultaneous push judgment control】**

This setting is effective when IFSEL = "H"

INSEL	Function	Note
H	Simultaneous push banned	Only the dominant button will output when more than 2 buttons were pressed
L	Simultaneous push effective	Every button that was pressed will output

**【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.

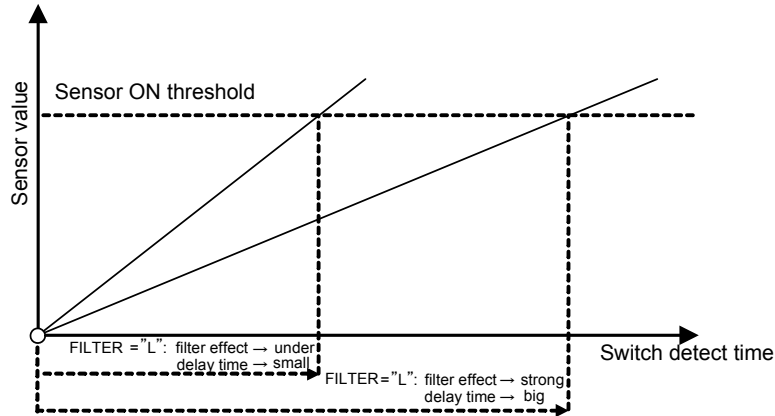
**【GAIN Selection】**

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 follows.

**【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.

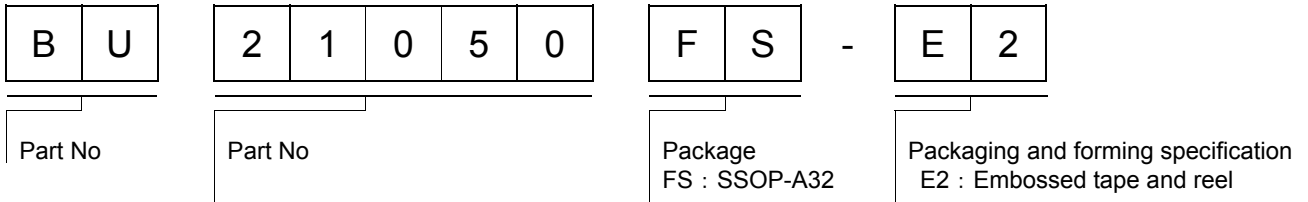
**【Shutdown Mode】**

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”.

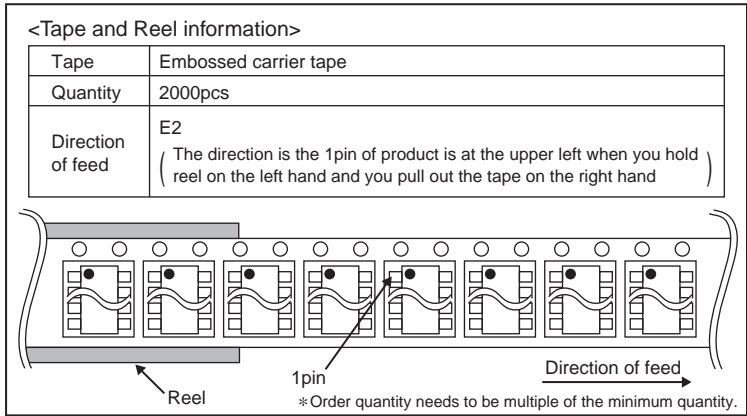
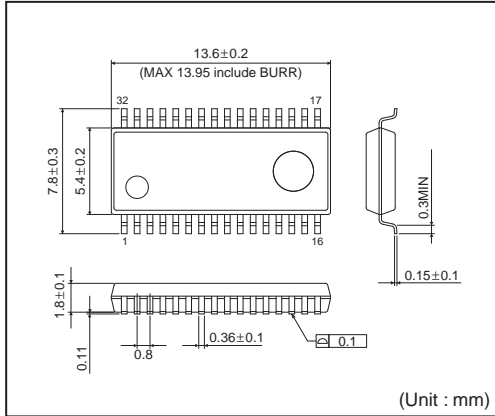
**●Power Supply ON Sequence**

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 part number



**SSOP-A32**



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