Capacitive Sensor Control IC Series

Capacitive Sensor Switch Control IC

BU21050FS

●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℃)

PARAMETER	SYMBOL	RATING		UNIT
		MIN	MAX	
Applied voltage	AVDD	-0.3	7.0	V
	DVDD	-0.3	7.0	
Input voltage	V_{AIN}	-0.3	AVDD + 0.3	V
	V_{DIN}	-0.3	DVDD + 0.3	
Storage temperature range	T_{stg}	-55	125	℃
Power dissipation	P_d	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	V
Operating temperature range	T_{opr}	-40	25	85	℃

●Electrical characteristics(Especially, Topr=25℃ 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_{IHIO}	DVDD x 0.9	-	DVDD + 0.2	V	
Input“L”voltage	V_{ILIO}	GND – 0.2	-	DVDD x 0.1	V	
Output“H”voltage	V_{OHIO}	DVDD x 0.8	-	DVDD	V	I_{OH} = -2[mA]。Overshoot is excluded。
Output“L”voltage	V_{OL}	GND	-	DVDD x 0.2	V	I_{OL} = 2[mA]。Undershoot is excluded。
Input leakage current	I_{IZ}	-1	-	1	μA	
Output leakage current	I_{OZ}	-	-	1	μA	
Standby current	I_{ST}	-	-	2	μA	Shutdown (SDN=“L”)
Operation current	I_{DD}	-	550	-	uA	

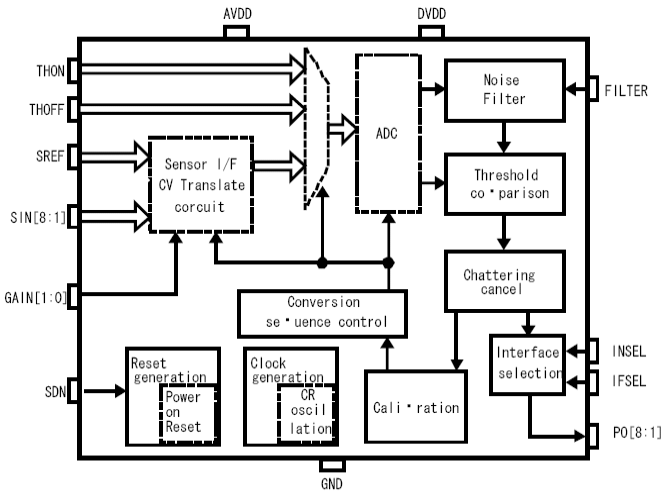
●A/D Converter

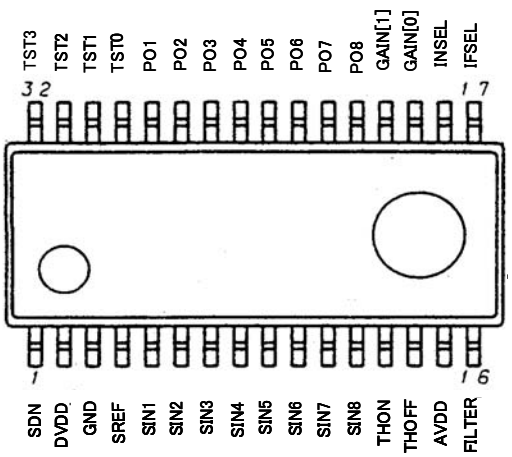
PARAMETER	SYMBOL	RATING			UNIT	Condition
		MIN	TYP	MAX		
Resolution		-	10	-	bit	
Analog Input voltage	V_{AIN}	GND	-	AVDD	V	
Change clock frequency	f_{adck}	0.2	-	2.0	MHz	
Change time	f_{tim}	-	13	-	μsec	f_{adck} = 1[MHz]
Zero scale voltage		-	-	GND + 0.07	V	
Full scale voltage		AVDD - 0.07	-	-	V	
Differential 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_{cr}	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.

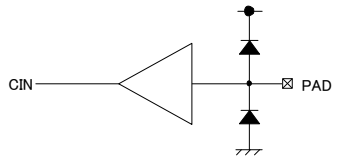
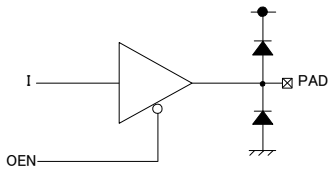
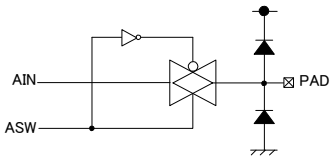
●Pin Description

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	AIn	Standard capacitor input	-	AVDD	"Hi-Z"		③
5	SIN1	AIn	Sensor input1	-	AVDD	"Hi-Z"		③
6	SIN2	AIn	Sensor input 2	-	AVDD	"Hi-Z"		③
7	SIN3	AIn	Sensor input 3	-	AVDD	"Hi-Z"		③
8	SIN4	AIn	Sensor input 4	-	AVDD	"Hi-Z"		③
9	SIN5	AIn	Sensor input 5	-	AVDD	"Hi-Z"		③
10	SIN6	Ain	Sensor input 6	-	AVDD	"Hi-Z"		③
11	SIN7	AIn	Sensor input 7	-	AVDD	"Hi-Z"		③
12	SIN8	AIn	Sensor input 8	-	AVDD	"Hi-Z"		③
13	THON	AIn	Sensor ON threshold voltage input	-	AVDD	"Hi-Z"		③
14	THOFF	AIn	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[1:0] = 10 : ↑ Gain GAIN[1:0] = 11 : Week	DVDD			①
20	GAIN[1]	In			DVDD			①
21	PO8	Out	sensor output8	-	DVDD	"Hi-Z"*2	"L"*3	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

①CMOS INPUT	②CMOS 3state output	③CMOS 3state output with analog switch
		

【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.

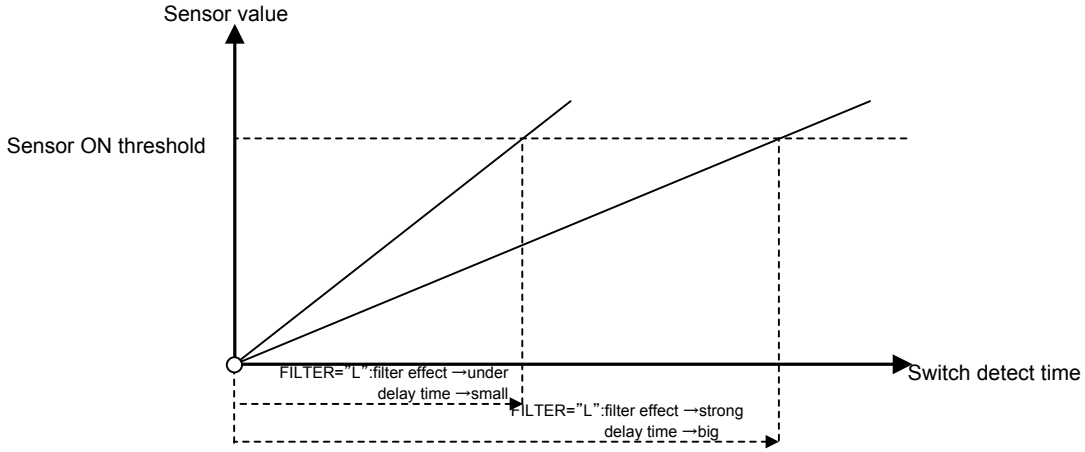
【GAIN Selection】

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 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 part number

B	U	2	1	0	5	0	F	S	−	E	2

Part No. (BU)

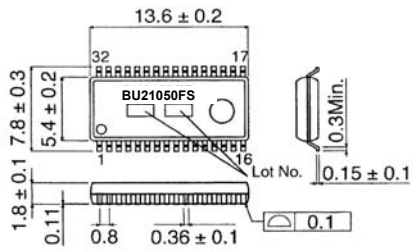
Part No (21050)

Package
FS : SSOP-A32

Packaging and forming specification
E2 : Embossed tape and reel

SSOP-A32

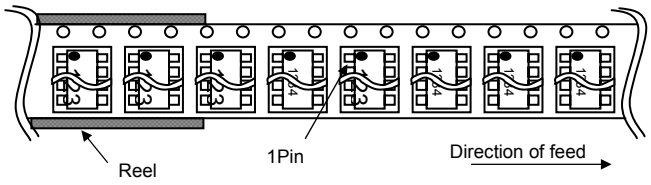
〈Dimension〉



(Unit:mm)

〈Tape and Reel information〉

Tape	Embossed carrier tape
Quantity	2000pcs
Direction	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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