

Features

- Operating voltage: 2.2V~5.5V
- Ultra low standby current: 1.5 μ A at 3V
- Auto-calibration
- High reliability touch detections
- High PSRR
- Output type: Level-hold or Toggle
- One-key or Any-key Wake-up Mode
- Wake-up Mode set by pins or serial command
- Open drain NMOS output
- Key status monitored using pins or serial bus

General Description

The BS801B/02B/04B/06B/08B are a range of 1 to 8 key touch key devices which can detect human body contact using external touch pads. The high level of device integration enable applications to be implemented with a minimum number of external components.

The BS804B and BS808B are equipped with a One-line serial interface to allow easy communication with an external MCU for device setup and for touch pin monitoring purposes.

Special internal circuitry is also employed to ensure excellent power noise rejection to reduce the possibility of false detections, increasing the touch switch application reliability under adverse environmental conditions.

With auto-calibration, low standby current and a choice of wake-up features, this range of touch key devices provides a simple and effective means of implementing touch switches in a wide variety of applications.

Selection Table

Part. No.	Touch Keys	Standby Current at 3V		Key Output Type	Package	Serial Interface	Auto Calibration
		One-Key Wake-up	Any-key Wake-up				
BS801B	1-Key	1.5μA	—	Level-Hold or Toggle	SOT23-6	—	√
BS802B	2-Key	—	2.0μA	Level-Hold or Toggle	8SOP	—	
BS804B	4-Key	1.5μA	3.0μA	—	8SOP	√	
				Level-Hold or Toggle	16NSOP		
BS806B	6-Key	1.5μA	4.0μA	Level-Hold	16NSOP	—	
BS808B	8-Key	1.5μA	5.0μA	—	16NSOP	√	
				Level-Hold	20SOP/SSOP	—	

The diagrams show the pin configurations for six different packages:

- BS801B SOT23-6-A**: A 6-pin package. Pin 1 is Kout, Pin 2 is VSS, Pin 3 is Key, Pin 4 is Cref, Pin 5 is VDD, and Pin 6 is LHF.
- BS802B 8 SOP-A**: An 8-pin package. Pin 1 is Key0, Pin 2 is Kout1, Pin 3 is Kout0, Pin 4 is VSS, Pin 5 is LHF, Pin 6 is VDD, Pin 7 is Key1, and Pin 8 is Cref.
- BS804B 8 SOP-A**: An 8-pin package. Pin 1 is Key1, Pin 2 is Key2, Pin 3 is Key3, Pin 4 is Cref, Pin 5 is VSS, Pin 6 is VDD, Pin 7 is SCD, and Pin 8 is Key0.
- BS806B 16 NSOP-A**: A 16-pin package. Pin 1 is Key0, Pin 2 is Key1, Pin 3 is Key2, Pin 4 is Key3, Pin 5 is Key4, Pin 6 is Key5, Pin 7 is Cref, Pin 8 is VSS, Pin 9 is OKW, Pin 10 is VDD, Pin 11 is Kout5, Pin 12 is Kout4, Pin 13 is Kout3, Pin 14 is Kout2, Pin 15 is Kout1, and Pin 16 is Kout0.
- BS808B 16 NSOP-A**: A 16-pin package. Pin 1 is Key0, Pin 2 is Key1, Pin 3 is Key2, Pin 4 is Key3, Pin 5 is Key4, Pin 6 is Key5, Pin 7 is Key6, Pin 8 is Key7, Pin 9 is Cref, Pin 10 is VSS, Pin 11 is VDD, Pin 12 is SCD, Pin 13 is NC, Pin 14 is NC, Pin 15 is NC, and Pin 16 is Key2.
- BS808B 20 SOP-A/SSOP-A**: A 20-pin package. Pin 1 is Key0, Pin 2 is Key1, Pin 3 is Key2, Pin 4 is Key3, Pin 5 is Key4, Pin 6 is Key5, Pin 7 is Key6, Pin 8 is Key7, Pin 9 is Cref, Pin 10 is VSS, Pin 11 is OKW, Pin 12 is VDD, Pin 13 is Kout7, Pin 14 is Kout6, Pin 15 is Kout5, Pin 16 is Kout4, Pin 17 is Kout3, Pin 18 is Kout2, Pin 19 is Kout1, and Pin 20 is Kout0.

The pins in the following table are common to all devices.

Pin Name	I/O	Description
Key0~Keyn	Input	Touch key n input. These pins are connected to the external touch key.
Kout0~Koutn	Output	Touch key n output pin.
Cref	Input	Touch key reference capacitor input - value range of 0pF to 10pF - higher capacitance values result in higher sensitivities.
VSS	—	Negative power supply, ground
VDD	—	Positive power supply

The following table shows device specific pins.

Pin Name	I/O	Device	Description
OKW	Input	BS804B BS806B BS808B	Selects One-key wake-up or Any-key wake-up. Pin condition is read during power-up. The logic status of this pin must not be changed after power-on. After power-on this pin's function can be overridden by a serial command on relevant devices. Pin connected to an internal pull-high resistor. Internal circuitry ensures that this pull high resistor will not consume current even if the input is low. Open: One-key wake-up using key0 only Low: Any-Key wake-up
SCD	Input/ Output	BS804B BS808B	Serial bus pin used to communicate with an external MCU. The external MCU can read the BS804B or BS808B touch key status and also send commands to the device via this pin.
LHF	Input	BS801B BS802B BS804B	Selects Key Output Type Pin condition is read during power-up. The logic status of this pin must not be changed after power-on. After power-on this pin's function can be overridden by a serial command on relevant devices. Pin connected to an internal pull-high resistor. Internal circuitry ensures that this pull high resistor will not consume current even if the input is low. Open: Level-Hold output Low: Toggle output

Note: It is important that the logic level of the OKW and LHF pins do not change state after power-on.

Absolute Maximum Ratings

Supply Voltage	$V_{SS}-0.3V$ to $V_{SS}+6.0V$	Storage Temperature	$-50^{\circ}C$ to $125^{\circ}C$
Input Voltage	$V_{SS}-0.3V$ to $V_{DD}+0.3V$	Operating Temperature	$-40^{\circ}C$ to $85^{\circ}C$
I_{OL} Total	80mA	Total Power Dissipation	500mW

Note: These are stress ratings only. Stresses exceeding the range specified under "Absolute Maximum Ratings" may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

D.C. Characteristics

BS801B

$T_a=25^{\circ}C$

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		V_{DD}	Conditions				
V_{DD}	Operating Voltage	—	—	2.2	—	5.5	V
I_{STB}	Standby Current	3V	No load	—	1.5	2.5	μA
I_{DD}	Operating Current	3V	No load	—	3	6	μA
V_{IH}	Input High Voltage	—	—	$0.7V_{DD}$	—	V_{DD}	V
V_{IL}	Input Low Voltage	—	—	0	—	$0.3V_{DD}$	V
I_{OL}	Sink Current	3V	$V_{OL}=0.1V_{DD}$	4	8	—	mA
R_{PH}	Pull-high Resistance	3V	—	20	60	100	$k\Omega$

BS802B

$T_a=25^{\circ}C$

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		V_{DD}	Conditions				
V_{DD}	Operating Voltage	—	—	2.2	—	5.5	V
I_{STB}	Standby Current, Any Key Wake-up	3V	No load	—	2	3	μA
I_{DD}	Operating Current	3V	No load	—	5	10	μA
V_{IH}	Input High Voltage	—	—	$0.7V_{DD}$	—	V_{DD}	V
V_{IL}	Input Low Voltage	—	—	0	—	$0.3V_{DD}$	V
I_{OL}	Sink Current	3V	$V_{OL}=0.1V_{DD}$	4	8	—	mA
R_{PH}	Pull-high Resistance	3V	—	20	60	100	$k\Omega$

BS804B

Ta=25°C

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		V _{DD}	Conditions				
V _{DD}	Operating Voltage	—	—	2.2	—	5.5	V
I _{STB1}	Standby Current - One-key Wake-up	3V	No load	—	1.5	2.5	μA
I _{STB2}	Standby Current - Any-Key Wake-up	3V	No load		3	5	μA
I _{DD}	Operating Current	3V	No load	—	8	16	μA
V _{IH}	Input High Voltage	—	—	0.7V _{DD}	—	V _{DD}	V
V _{IL}	Input Low Voltage	—	—	0	—	0.3V _{DD}	V
I _{OL}	Sink Current	3V	V _{OL} =0.1V _{DD}	4	8	—	mA
R _{PH}	Pull-high Resistance	3V	—	20	60	100	kΩ

BS806B

Ta=25°C

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		V _{DD}	Conditions				
V _{DD}	Operating Voltage	—	—	2.2	—	5.5	V
I _{STB1}	Standby Current - One-key Wake-up	3V	No load	—	1.5	2.5	μA
I _{STB2}	Standby Current - Any-Key Wake-up	3V	No load		4.0	6.5	μA
I _{DD}	Operating Current	3V	No load	—	14	28	μA
V _{IH}	Input High Voltage	—	—	0.7V _{DD}	—	V _{DD}	V
V _{IL}	Input Low Voltage	—	—	0	—	0.3V _{DD}	V
I _{OL}	Sink Current	3V	V _{OL} =0.1V _{DD}	4	8	—	mA
R _{PH}	Pull-high Resistance	3V	—	20	60	100	kΩ

BS808B

Ta=25°C

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		V _{DD}	Conditions				
V _{DD}	Operating Voltage	—	—	2.2	—	5.5	V
I _{STB1}	Standby Current - One-key Wake-up	3V	No load	—	1.5	2.5	μA
I _{STB2}	Standby Current - Any-Key Wake-up	3V	No load		5	8	μA
I _{DD}	Operating Current	3V	No load	—	18	36	μA
V _{IH}	Input High Voltage	—	—	0.7V _{DD}	—	V _{DD}	V
V _{IL}	Input Low Voltage	—	—	0	—	0.3V _{DD}	V
I _{OL}	Sink Current	3V	V _{OL} =0.1V _{DD}	4	8	—	mA
R _{PH}	Pull-high Resistance	3V	—	20	60	100	kΩ

A.C. Characteristics

Ta=25°C

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		V _{DD}	Conditions				
f _{SCD}	SCD Clock	3V	—	10.4	13.0	15.6	kHz
f _{KRT1}	Key Response Time in Normal Mode	3V	—	75	100	125	ms
t _{KRT2}	Key Response Time in Standby Mode	3V	—	300	400	500	ms
t _{KH}	Maximum Key Hold Time	3V	—	30	40	50	s
t _{CAL1}	Auto-Calibration Period - Normal Mode	3V	—	1.8	2.5	3.2	s
t _{CAL2}	Auto-Calibration Period - Standby Mode	3V	—	7.5	10.0	12.5	s

Functional Description

Introduction

This range of BS80xB touch key devices offer an easy and reliable means of implementing touch switch functions in a range of applications. A single external capacitor is the only external component required for most applications while a single line serial bus offers convenient communication with an external MCU.

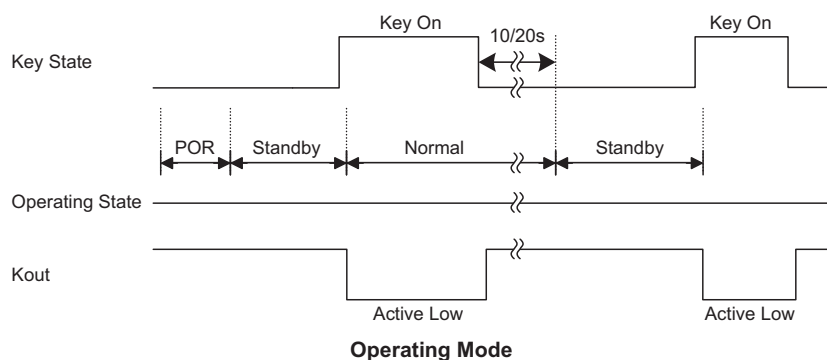
Device Operation Modes

All devices have two modes of operation, the Standby Mode and the Normal Mode. After the device is powered up it will automatically enter the Standby Mode to conserve power. The BS801B and BS802B devices can then be woken up by touching any of their Key_n pins. The BS804B, BS806B and BS808B devices can however be woken up by either a One-key Wake-up using Key₀, or by Any-key Wake-up. The wake-up method is determined by the status of the OKW pin which is read only during power-on. The advantage of choosing the One-key wake-up option is that it consumes less power than the Any-key wake-up when in the Standby Mode.

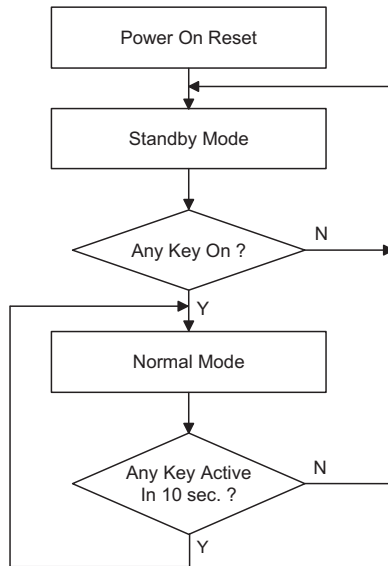
Part No.	OKW Open	OKW Low
BS804B BS806B BS808B	One-key Wake-up	Any-key Wake-up

The logic status of the OKW pin is read when the device powers up. The logic level on this pin must not be changed after power on. Internal circuitry ensures that the internal pull-high resistor on the OKW pin will not consume current.

Part No.	Normal Mode On Time
BS801B BS802B	Approx 10 sec
BS804B BS806B BS808B	Approx 20 secs



When in the Standby Mode, after a relevant Key wake-up detection has been made, the device will switch to the Normal Mode and await subsequent switch detections on all their Key pins. It will remain in the Normal Mode for about 10 seconds for the BS801B and BS802B devices and for about 20 seconds for the other devices and if no further detections are made during this time will return to the Standby Mode.



BS801B and BS802B Operating Flow

Touch Key Outputs

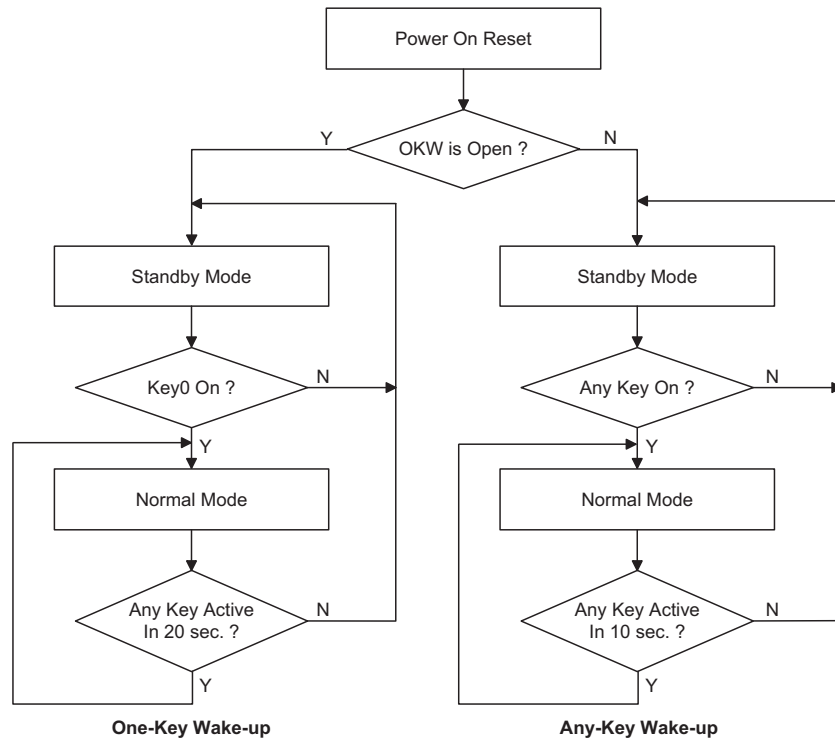
All Kout pins have NMOS structures to allow easy interfacing to external devices with different operating voltages. The BS801B, BS802 and BS804B devices can have their outputs configured to operate with either Level-Hold or Toggle type. The output type is determined by the status of the LHF pin which is read during power-on. The logic level on this pin must not be changed after power on. Internal circuitry ensures that the internal pull-high resistor on the LHF pin will not consume current. The BS806B and BS808B only have Level-Hold output types.

Part No.	LHF	Kout Type
BS801B BS802B BS804B	Open	Level-Hold
	Low	Toggle
BS806B BS808B	—	Level-Hold

Serial Interface – SCD

Both the BS804B and BS808B are equipped with a single line serial interface on the SCD pin, allowing for easy interfacing to an external MCU.

This single line interface allows communication in both directions between the touch key device and the external MCU. Using this interface, the external MCU can serially read the status of the touch keys at any time. The Serial interface also allows the external MCU to send commands to the touch key device. The serial interface al-



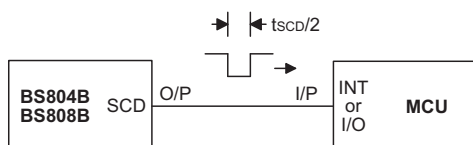
BS804B, BS806B and BS808B Operating Flow

lows three functions to be implemented, two are initiated by the external MCU and one by the BS80xB.

SCD Command	Direction
Wake-up or Interrupt MCU	BS804B/BS808B → MCU
Read Touch Key Status	Step1: MCU send command MCU → BS804B/BS808B Step2: MCU read key status BS804B/BS808B → MCU
Send command to BS804B/BS808B	MCU → BS804B/BS808B

SCD Function Summary

- BS804B/BS808B Wakes-up or Interrupts MCU
When any of the touch keys change state, a pulse will be generated by the BS804B/BS808B device which can be used to wake up or to interrupt an external MCU. The MCU must ensure that its pin connected to the SCD pin is setup as an input to receive this pulse. The pulse width generated by the device is equal to a $t_{SCD}/2$ period where t_{SCD} is about 76 μ s.



Wake-up/Interrupt Pulse to MCU

- MCU reads the touch key status
The MCU can send a command to the BS804B/BS808B device to request the touch key status. The protocol for reading the touch key status is as follows:
 - The external MCU takes control of the SCD line and first sends three rising edge pulses or more to the BS804B/BS808B within a time of about 152 μ s.
 - The MCU then changes its I/O pin to an input.
 - The BS804B/BS808B device will then pull the SCD line low, then high, the timings are given by synchronise period. This allows the MCU to synchronise itself for the data transfer.
 - The BS804B/BS808B device will then transmit its key status, given by D0~Dn
 - For the BS804B, the data format is D0~D3.
 - For the BS808B, the data format is D0~D7.
 - The MCU can then read the key status taking care to read the data in the centre of the transmitted data pulse.
 - After the last data bit is transferred the BS804B/BS808B device will return its SCD pin to an input state.

The timings associated with the above protocol can be described in multiples of the SCD clock periods. The SCD clock period is about 76 μ s.

A certain time is required for the MCU to transmit three or more pulses to inform the device that it desires to

read the key status. After this time has elapsed the device will then transmit the data bits, D0~Dn.

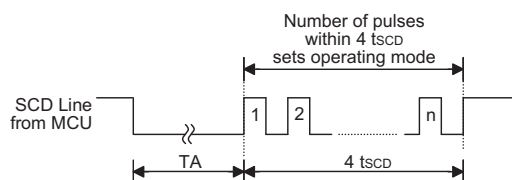
Device	Time
BS804B	22 t_{SCD}
BS808B	38 t_{SCD}

Key Status Read Total Time

Each bit of transmitted data corresponds directly to a touch input key. Therefore the status of touch key Key0 is represented by D0, Key1 by D1 and so on. A "low" bit means that a touch has been detected, a "high" bit means no touch has been detected.

Pin	Data Bit	Dn Value
Key0	D0	1: Key Off 0: Key On
Key1	D1	
:	:	
:	:	
Keyn	Dn	

- MCU sends commands to BS804B/BS808B device
The MCU can send commands along the SCD line to setup the device in different Operating Modes. To do this the externally connected MCU takes control of the SCD line, first forcing it low and holding it low for a time of greater than 8 t_{SCD} cycles. This action will temporarily disable the device and enable it to receive the command from the MCU. Any command sent to the device from the MCU will override the original power on configuration setup.



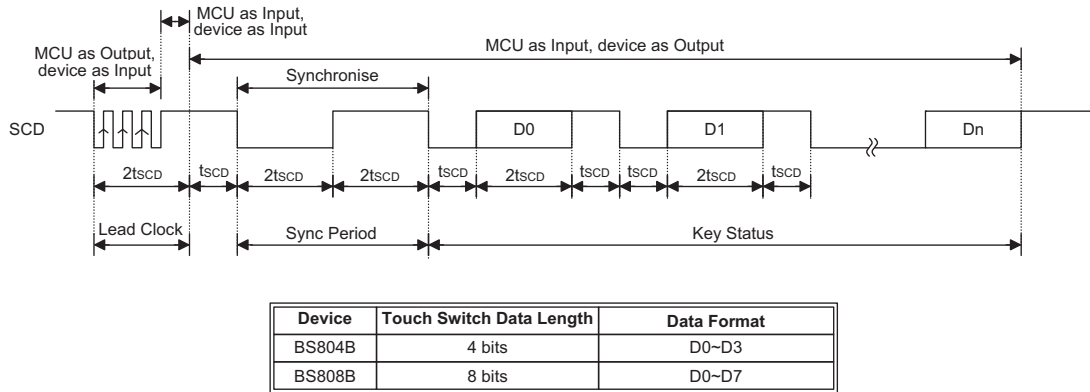
Note: $T_A > 8 t_{SCD}$ Periods

SCD Device Setup

The desired Operating Mode to be setup depends upon the number of pulses received by BS804B/BS808B within a time period, 4 t_{SCD} , as shown in the table. After the programming clock cycles have been transmitted and the SCD line returns high, the device will return to normal operation.

Clock Pulses	Operating Mode
0~2	Set by external pin
3~6	One-key wake-up
7~10	For test purposes
11~14	Any-Key wake-up
>15	Always normal operation

BS804B and BS808B SCD Commands



SCD Pin Touch Key Status Request

Note that the MCU must transmit these pulses within 4 t_{SCD} .

Maximum Key On Duration Time

To minimise the possibility of unintentional switch detections, such as undesired objects covering the sense electrodes, the devices include a Maximum Key-On duration time function. To implement this function the devices include an internal timer, which starts running after each switch detection. If the key on time of a touch key exceeds a value of about 40 seconds, then the device will be reset to its power-on condition and initiate a new auto calibration. The output will then remain inactive until the next switch detection.

Auto-calibration Function

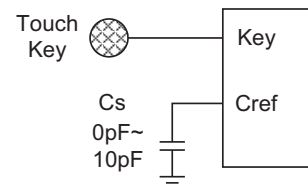
The devices include a full auto-calibration function which will be initiated after the device is powered-on. In addition to the power-on calibration, if no switch detection has been made for more than about 2.5 seconds then a further calibration procedure will be carried out. The calibration is applied independently to each channel on the devices. By implementing this feature, changes in the touch key environmental conditions are automatically catered for dynamically.

Sensitivity Adjustment

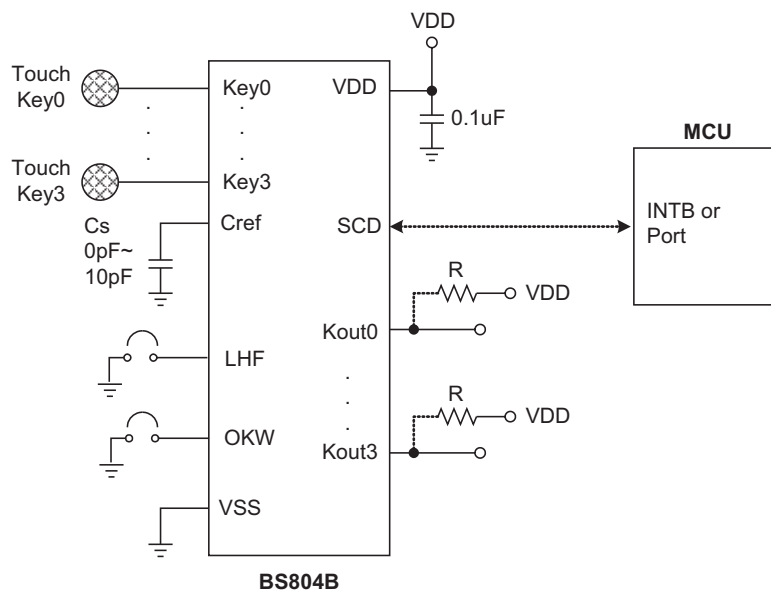
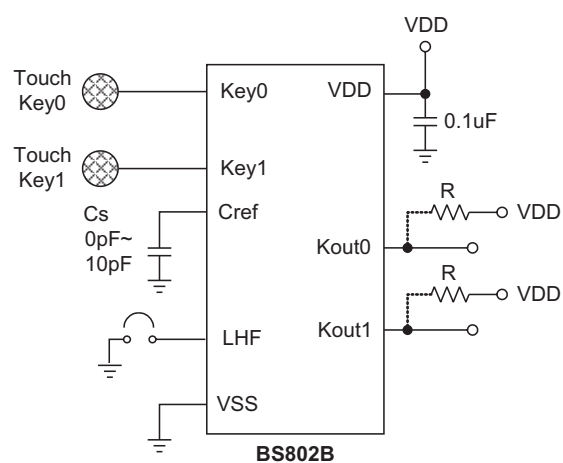
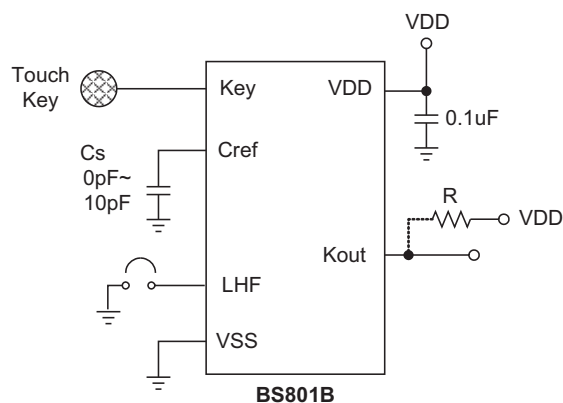
The sensitivity of the switch is a very important consideration in most applications whose requirements will vary according to the user application. The user should therefore be aware of the factors which will affect the overall sensitivity of their touch key application. Factors to take into consideration include the electrode size and the capacitance of the connection lines from the electrode to the BS80xB device. Therefore the sensitivity will vary according to the actual PCB layout and design.

An external capacitor, C_s , connected to the Cref pin, is used to set the overall sensitivity of all pins. Some of the most important factors affecting sensitivity are the following:

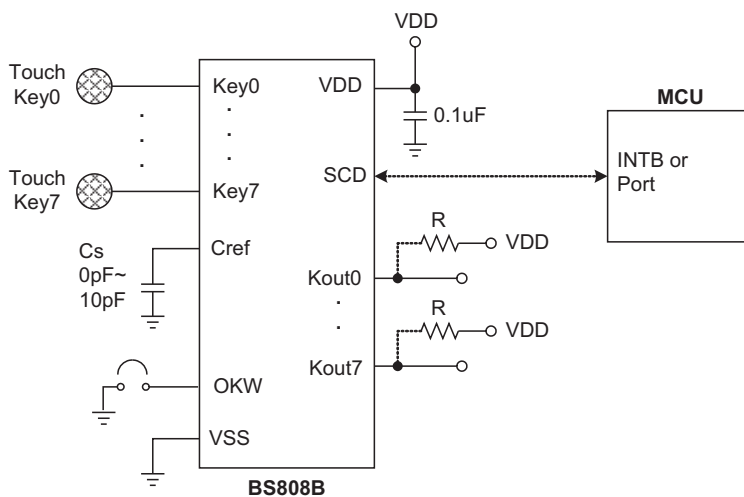
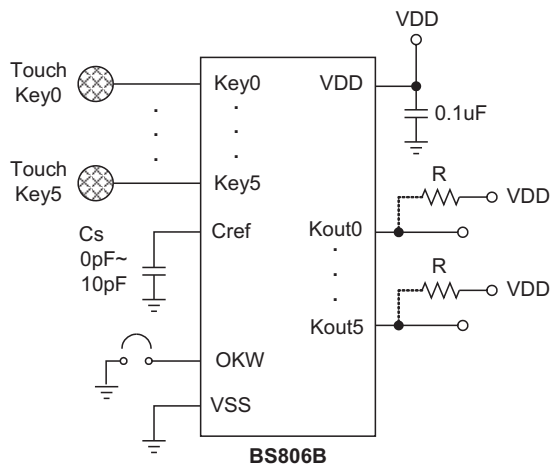
- Cref capacitor value - C_s
The purpose of the C_s capacitor is to allow for adjustment of touch key sensitivity and power noise rejection. The optimal choice of sensitivity and power noise rejection will be obtained when the value of the C_s capacitor is equivalent to the touch pad capacitance, however the value can still be changed to obtain the required sensitivity value. Higher C_s values will result in higher levels of sensitivity. Recommended values for C_s are between 0pF and 10pF.
- Touch key pad size
Larger touch key sizes will increase sensitivity and of course vice-versa, small electrode sizes will decrease sensitivity.
- Touch key pad insulating panel thickness
A thinner panel will result in higher sensitivity and of course thicker panels will result in a lower sensitivities.
- Touch key pad insulating panel material
The choice of the dielectric material for the panel will influence the sensitivity. Materials with higher dielectric constants will result in higher sensitivities and lower dielectric constants will result in lower sensitivities.



Application Circuit



Note: If the output is connected to an MCU input with an internal pull high resistor then the pull high resistor on the application circuit is not required.



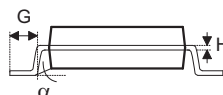
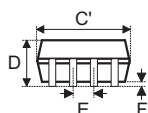
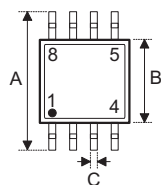
Note: If the output is connected to an MCU input with an internal pull high resistor then the pull high resistor on the application circuit is not required.

Package Information

Note that the package information provided here is for consultation purposes only. As this information may be updated at regular intervals users are reminded to consult the [Holtek website](#) for the latest version of the [Package/Carton Information](#).

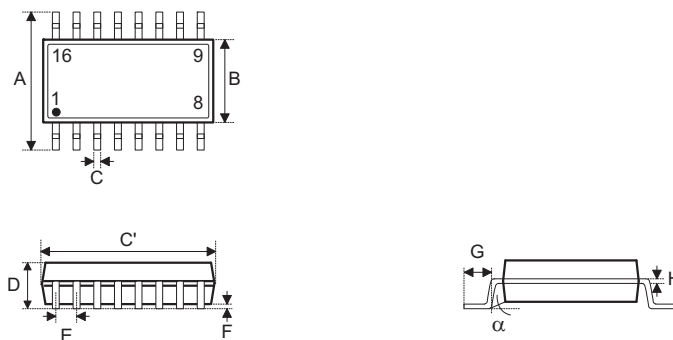
Additional supplementary information with regard to packaging is listed below. Click on the relevant section to be transferred to the relevant website page.

- [Further Package Information \(include Outline Dimensions, Product Tape and Reel Specifications\)](#)
- [Packing Materials Information](#)
- [Carton Information](#)

8-pin SOP (150mil) Outline Dimensions


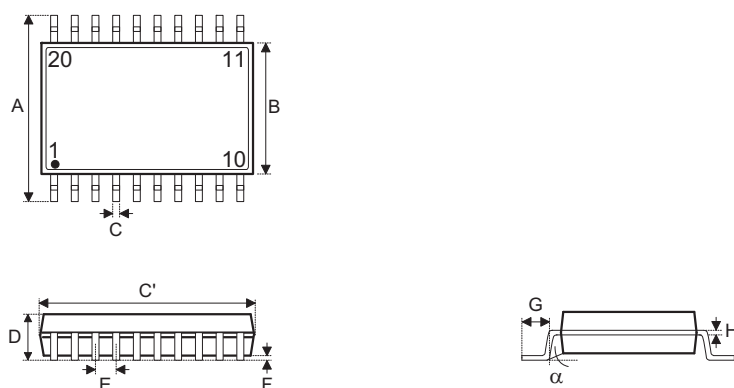
Symbol	Dimensions in inch		
	Min.	Nom.	Max.
A	—	0.236 BSC	—
B	—	0.154 BSC	—
C	0.012	—	0.020
C'	—	0.193 BSC	—
D	—	—	0.069
E	—	0.050 BSC	—
F	0.004	—	0.010
G	0.016	—	0.050
H	0.004	—	0.010
α	0°	—	8°

Symbol	Dimensions in mm		
	Min.	Nom.	Max.
A	—	6.00 BSC	—
B	—	3.90 BSC	—
C	0.31	—	0.51
C'	—	4.90 BSC	—
D	—	—	1.75
E	—	1.27 BSC	—
F	0.10	—	0.25
G	0.40	—	1.27
H	0.10	—	0.25
α	0°	—	8°

16-pin NSOP (150mil) Outline Dimensions


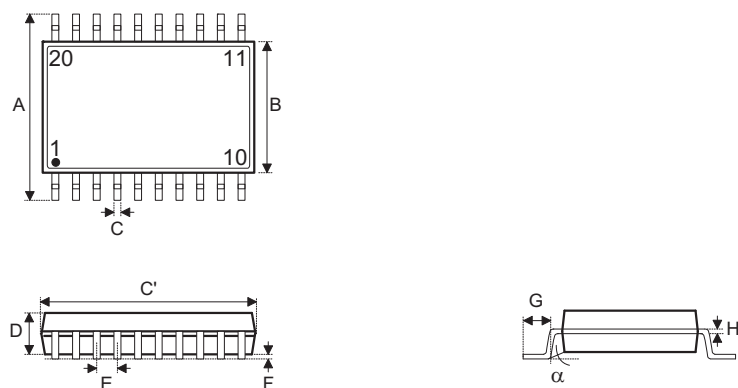
Symbol	Dimensions in inch		
	Min.	Nom.	Max.
A	—	0.236 BSC	—
B	—	0.154 BSC	—
C	0.012	—	0.020
C'	—	0.390 BSC	—
D	—	—	0.069
E	—	0.050 BSC	—
F	0.004	—	0.010
G	0.016	—	0.050
H	0.004	—	0.010
α	0°	—	8°

Symbol	Dimensions in mm		
	Min.	Nom.	Max.
A	—	6.000 BSC	—
B	—	3.900 BSC	—
C	0.31	—	0.51
C'	—	9.900 BSC	—
D	—	—	1.75
E	—	1.270 BSC	—
F	0.10	—	0.25
G	0.40	—	1.27
H	0.10	—	0.25
α	0°	—	8°

20-pin SOP (300mil) Outline Dimensions


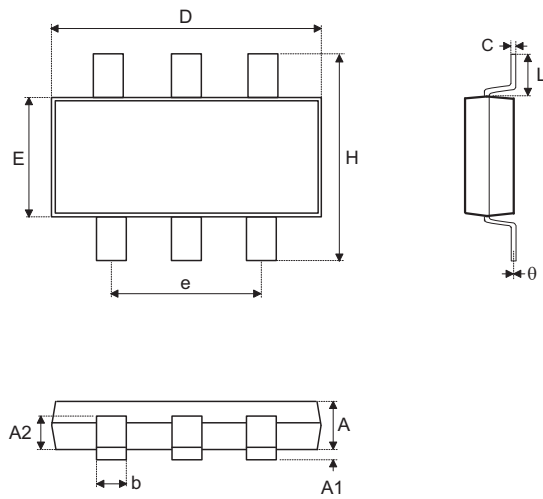
Symbol	Dimensions in inch		
	Min.	Nom.	Max.
A	—	0.406 BSC	—
B	—	0.295 BSC	—
C	0.012	—	0.020
C'	—	0.504 BSC	—
D	—	—	0.104
E	—	0.050 BSC	—
F	0.004	—	0.012
G	0.016	—	0.050
H	0.008	—	0.013
α	0°	—	8°

Symbol	Dimensions in mm		
	Min.	Nom.	Max.
A	—	10.30 BSC	—
B	—	7.50 BSC	—
C	0.30	—	0.51
C'	—	12.80 BSC	—
D	—	—	2.65
E	—	1.27 BSC	—
F	0.10	—	0.30
G	0.41	—	1.27
H	0.20	—	0.33
α	0°	—	8°

20-pin SSOP (150mil) Outline Dimensions


Symbol	Dimensions in inch		
	Min.	Nom.	Max.
A	—	0.236 BSC	—
B	—	0.155 BSC	—
C	0.008	—	0.012
C'	—	0.341 BSC	—
D	—	—	0.069
E	—	0.025 BSC	—
F	0.004	—	0.010
G	0.016	—	0.050
H	0.004	—	0.010
α	0°	—	8°

Symbol	Dimensions in mm		
	Min.	Nom.	Max.
A	—	6.000 BSC	—
B	—	3.900 BSC	—
C	0.20	—	0.30
C'	—	8.660 BSC	—
D	—	—	1.75
E	—	0.635 BSC	—
F	0.10	—	0.25
G	0.41	—	1.27
H	0.10	—	0.25
α	0°	—	8°

6-pin SOT23 Outline Dimensions


Symbol	Dimensions in inch		
	Min.	Nom.	Max.
A	—	—	0.057
A1	—	—	0.006
A2	0.035	0.045	0.051
b	0.012	—	0.020
C	0.003	—	0.009
D	—	0.114 BSC	—
E	—	0.063 BSC	—
e	—	0.037 BSC	—
E1	—	0.075 BSC	—
H	—	0.110 BSC	—
L	0.012	0.018	0.024
θ	0°	—	8°

Symbol	Dimensions in mm		
	Min.	Nom.	Max.
A	—	—	1.45
A1	—	—	0.15
A2	0.90	1.15	1.30
b	0.30	—	0.50
C	0.08	—	0.22
D	—	2.90 BSC	—
E	—	1.60 BSC	—
e	—	0.95 BSC	—
e1	—	1.90 BSC	—
H	—	2.80 BSC	—
L	0.30	0.45	0.60
θ	0°	—	8°

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