



BS801C/02C/04C/06C/08C Touch Key

Features

- Operating voltage: 2.2V~5.5V
- Ultra low current: 3.0 μ A at 3V
- Auto-calibration
- High reliability touch detections
- High PSRR
- Output type: Level-hold or Toggle
- One-key or Any-key State
- Key State Mode set by pins or serial command
- Open drain NMOS output
- Key status monitored using pins or serial bus

General Description

The BS801C/02C/04C/06C/08C 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 BS804C and BS808C 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.

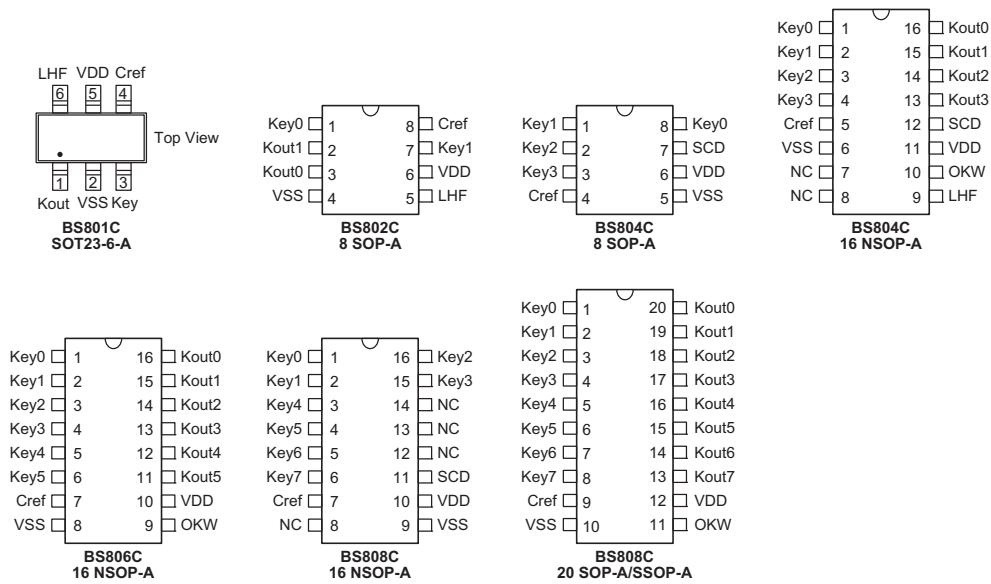
With auto-calibration, low operating current and a low power one-key operating state, this range of touch key devices provides a simple and effective means of implementing touch switches in a wide variety of applications.

Selection Table

Part. No.	Touch Keys	Operating Current at 3V		Key Output Type	Package	Serial Interface	Auto Calibration
		One-Key State	Any-key State				
BS801C	1-Key	3.0 μ A	—	Level-Hold or Toggle	SOT23-6	—	√
BS802C	2-Key	—	5.0 μ A	Level-Hold or Toggle	8SOP	—	
BS804C	4-Key	3.0 μ A	8.0 μ A	—	8SOP	√	
				Level-Hold or Toggle	16NSOP		
BS806C	6-Key	3.0 μ A	14.0 μ A	Level-Hold	16NSOP	—	
BS808C	8-Key	3.0 μ A	18.0 μ A	—	16NSOP	√	
				Level-Hold	20SOP/SSOP	—	

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Pin Assignment



Pin Description

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	BS804C BS806C BS808C	Selects One-key State or Any-key State. 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 State using key0 only Low: Any-Key State
SCD	Input/ Output	BS804C BS808C	Serial bus pin used to communicate with an external MCU. The external MCU can read the BS804C or BS808C touch key status and also send commands to the device via this pin.
LHF	Input	BS801C BS802C BS804C	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	I_{OH} 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
BS801C

Ta=25°C

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		V _{DD}	Conditions				
V _{DD}	Operating Voltage	—	—	2.2	—	5.5	V
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	kΩ

BS802C

Ta=25°C

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		V _{DD}	Conditions				
V _{DD}	Operating Voltage	—	—	2.2	—	5.5	V
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	kΩ

BS801C/02C/04C/06C/08C
BS804C

Ta=25°C

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		V _{DD}	Conditions				
V _{DD}	Operating Voltage	—	—	2.2	—	5.5	V
I _{DD1}	Operating Current - One-key State	3V	No load	—	3.0	6.0	μA
I _{DD2}	Operating Current - Any-Key State	3V	No load		8.0	16.0	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

BS806C

Ta=25°C

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		V _{DD}	Conditions				
V _{DD}	Operating Voltage	—	—	2.2	—	5.5	V
I _{DD1}	Operating Current - One-key State	3V	No load	—	3.0	6.0	μA
I _{DD2}	Operating Current - Any-Key State	3V	No load		14.0	28.0	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

BS808C

Ta=25°C

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		V _{DD}	Conditions				
V _{DD}	Operating Voltage	—	—	2.2	—	5.5	V
I _{DD1}	Operating Current - One-key State	3V	No load	—	3.0	6.0	μA
I _{DD2}	Operating Current - Any-Key State	3V	No load		18.0	36.0	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 _{KRT}	Key Response Time	3V	—	75	100	125	ms
t _{KH}	Maximum Key Hold Time	3V	—	30	40	50	s
t _{CAL}	Auto-Calibration Period	3V	—	1.8	2.5	3.2	s

Functional Description
Introduction

This range of BS80xC 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 State

There are two operating states known as the One-key State and the Any-key State. Devices with an OKW pin, namely the BS804C, BS806C and BS808C, can operate in either the One-key State or the Any-key State. When these devices are powered up, the condition of the OKW pin will be automatically read. If the OKW pin is low then the device will enter the Any-key State and if the pin is floating the device will enter the One-key State. As the BS801C and BS802C devices do not have an OKW pin they will always operate in the Any-key State.

In the Any-key State, as the name suggests all of the Key touch inputs will be active, however in the One-key State only Key0 will be active. After power up if the BS804C, BS806C and BS808C device enters the One-key State then touching any Key other than Key0 will have no effect. If a touch action is however detected on Key0, then the device will enter the Any-key State and operate normally with all keys active. However, within a timer period of around 20 seconds, if no touch

actions are detected on any Key input, then the device will revert to the One-key State.

The advantage of choosing the One-key State over the Any-key State is that it will result in lower power consumption as only one key remains active. The logic status of the OKW pin is only read when the device powers up and will determine the operating state of the device after power-on. For the BS804C and BS808C devices, this power-on state can be overridden later by sending the appropriate command to the device on its SCD pin. The logic level on the OKW 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 after power-on.

Part No.	OKW Open	OKW Low
BS804C BS806C BS808C	One-key State	Any-key State

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.	Any-key On Time in One-key State
BS804C BS806C BS808C	Approx 20 secs

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Touch Key Outputs

All Kout pins have NMOS structures to allow easy interfacing to external devices with different operating voltages. The BS801C, BS802 and BS804C 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 BS806C and BS808C only have Level-Hold output types.

Part No.	LHF	Kout Type
BS801C	Open	Level-Hold
BS802C		
BS804C		
BS806C	Low	Toggle
BS808C		
BS806C	—	Level-Hold
BS808C		

Serial Interface – SCD

Both the BS804C and BS808C are equipped with a single line serial interface on the SCD pin, allowing for easy interfacing to an external MCU.

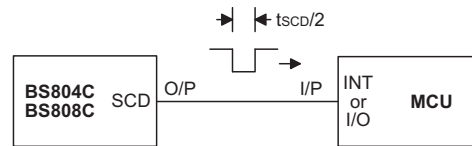
This single line interface allows communication in both directions between the touch key device and the external MCU. Using this interface, the external MCU can serially read the status of the touch keys at any time. The Serial interface also allows the external MCU to send com-

mands to the touch key device. The serial interface allows three functions to be implemented, two are initiated by the external MCU and one by the BS80xC.

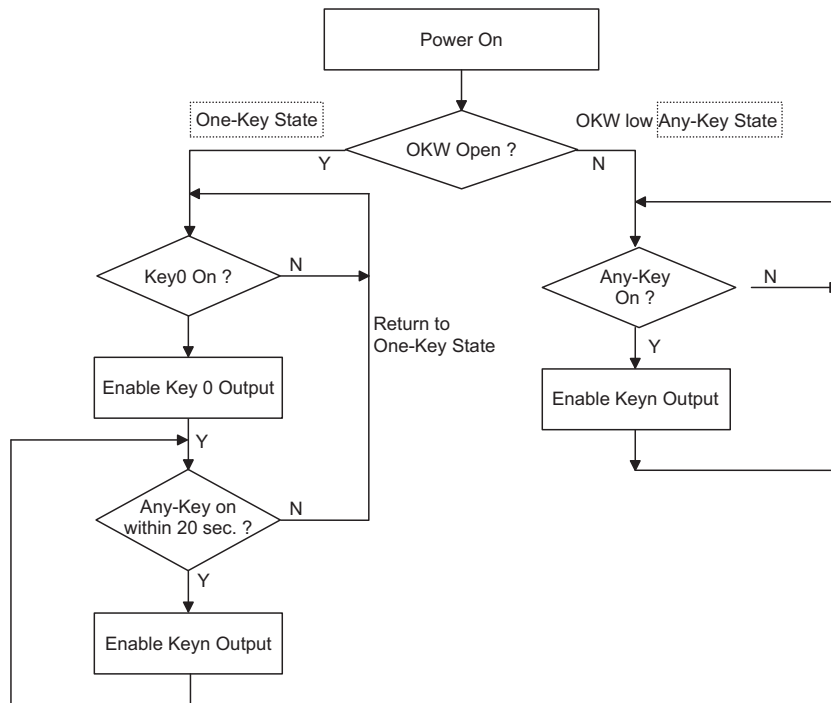
SCD Command	Direction
Wake-up or Interrupt MCU	BS804C/BS808C → MCU
Read Touch Key Status	Step1: MCU send command MCU → BS804C/BS808C
	Step2: MCU read key status BS804C/BS808C → MCU
Send command to BS804C/BS808C	MCU → BS804C/BS808C

SCD Function Summary

- BS804C/BS808C Wakes-up or Interrupts MCU
When any of the touch keys change state, a pulse will be generated by the BS804C/BS808C 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



BS804C, BS806C and BS808C Operating Flow

- MCU reads the touch key status
The MCU can send a command to the BS804C/BS808C 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 BS804C/BS808C within a time of about 152µs.
 - ♦ The MCU then changes its I/O pin to an input.
 - ♦ The BS804C/BS808C 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 BS804C/BS808C device will then transmit its key status, given by D0~Dn
 - For the BS804C, the data format is D0~D3.
 - For the BS808C, 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 BS804C/BS808C 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 76µs.

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
BS804C	22 t _{SCD}
BS808C	38 t _{SCD}

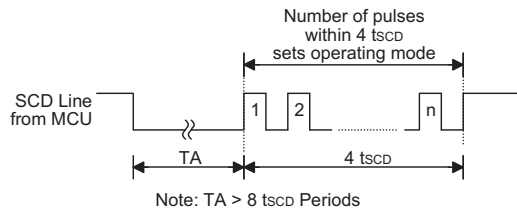
Key Status Read Total Time

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 BS804C/BS808C device
The MCU can send commands along the SCD line to setup the device in different Operating State. 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.



SCD Device Setup

The desired Operating Mode to be setup depends upon the number of pulses received by BS804C/BS808C 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	For test purposes
7~10	One-Key state
11~14	For test purposes
>15	Any-Key state

BS804C and BS808C SCD Commands

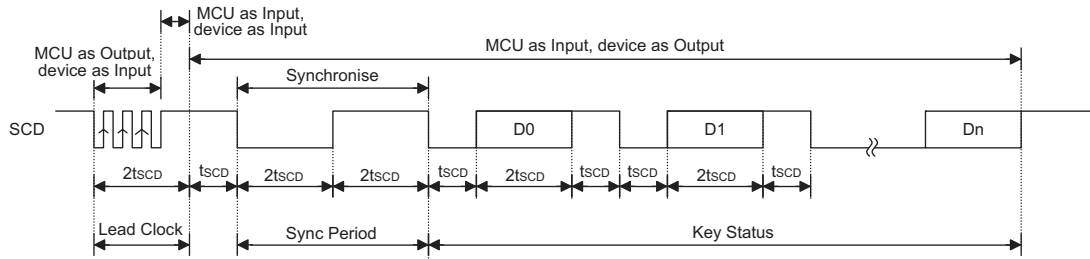
Note that the MCU must transmit these pulses within 4 t_{SCD}.

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.



Device	Touch Switch Data Length	Data Format
BS804C	4 bits	D0~D3
BS808C	8 bits	D0~D7

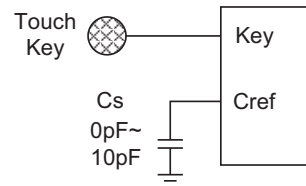
SCD Pin Touch Key Status Request

Sensitivity Adjustment

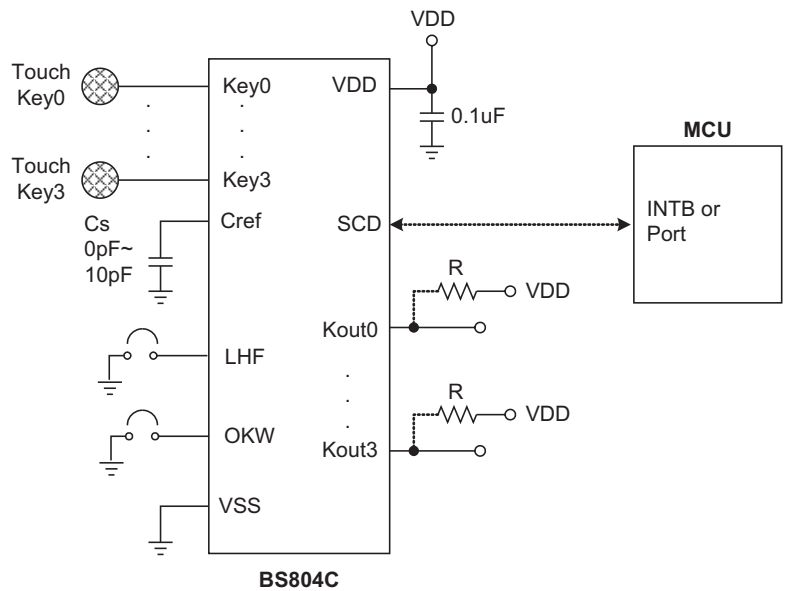
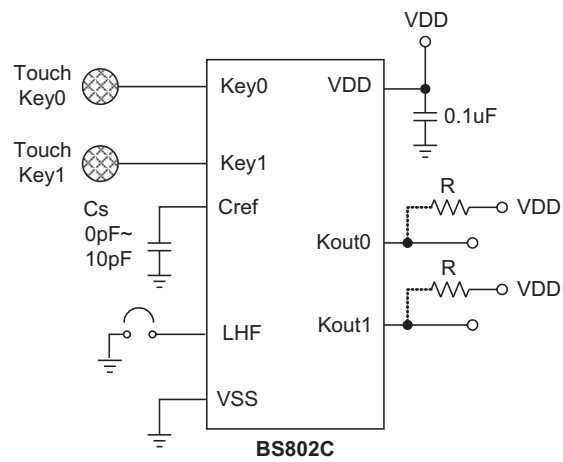
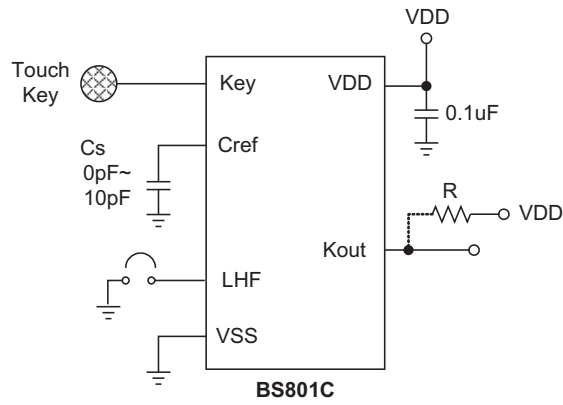
The sensitivity of the switch is a very important consideration in most applications whose requirements will vary according to the user application. The user should therefore be aware of the factors which will affect the overall sensitivity of their touch key application. Factors to take into consideration include the electrode size and the capacitance of the connection lines from the electrode to the BS80xC device. Therefore the sensitivity will vary according to the actual PCB layout and design. An external capacitor, Cs, 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 - Cs
The purpose of the Cs 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 Cs capacitor is equivalent to the touch pad capacitance, however the value can still be changed to obtain the required sensitivity value. Higher Cs values will result in higher levels of sensitivity. Recommended values for Cs 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.

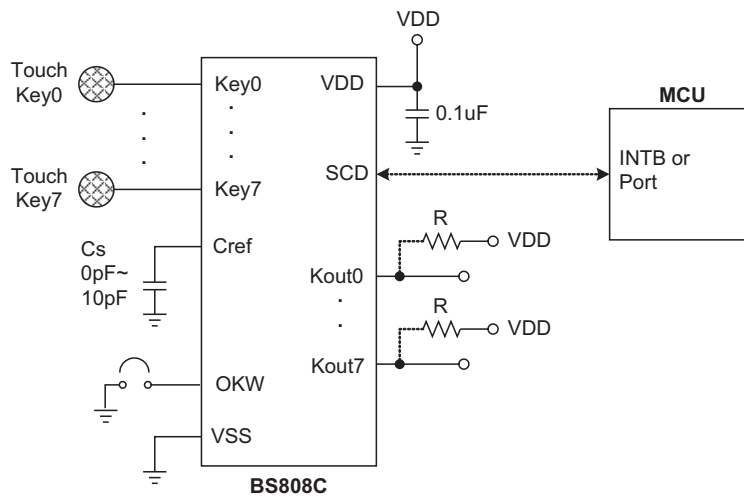
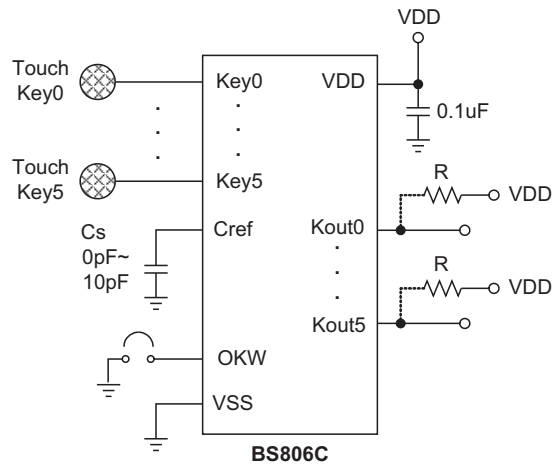


Application Circuit

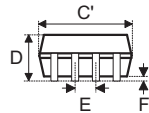
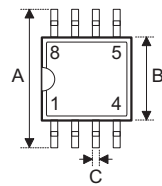


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Note: If the output is connected to an MCU input with an internal pull high resistor then the pull high resistor on the application circuit is not required.



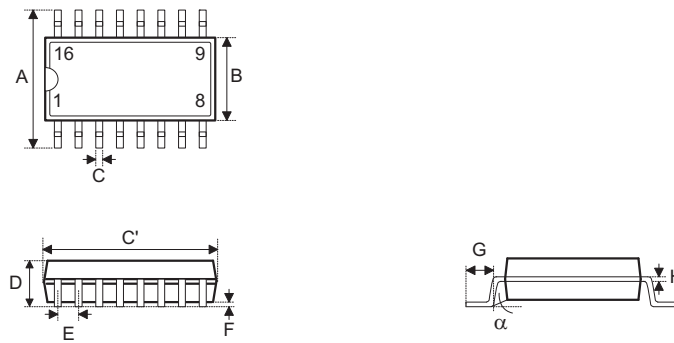
Note: If the output is connected to an MCU input with an internal pull high resistor then the pull high resistor on the application circuit is not required.

Package Information
8-pin SOP (150mil) Outline Dimensions


• MS-012

Symbol	Dimensions in mil		
	Min.	Nom.	Max.
A	228	—	244
B	150	—	157
C	12	—	20
C'	188	—	197
D	—	—	69
E	—	50	—
F	4	—	10
G	16	—	50
H	7	—	10
α	0°	—	8°

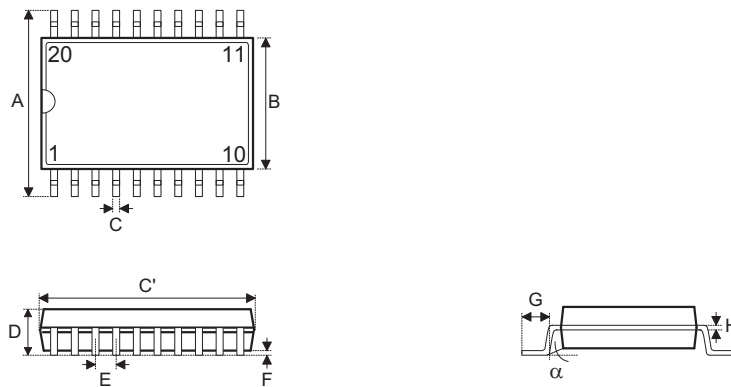
16-pin NSOP (150mil) Outline Dimensions



• MS-012

Symbol	Dimensions in mil		
	Min.	Nom.	Max.
A	228	—	244
B	150	—	157
C	12	—	20
C'	386	—	394
D	—	—	69
E	—	50	—
F	4	—	10
G	16	—	50
H	7	—	10
α	0°	—	8°

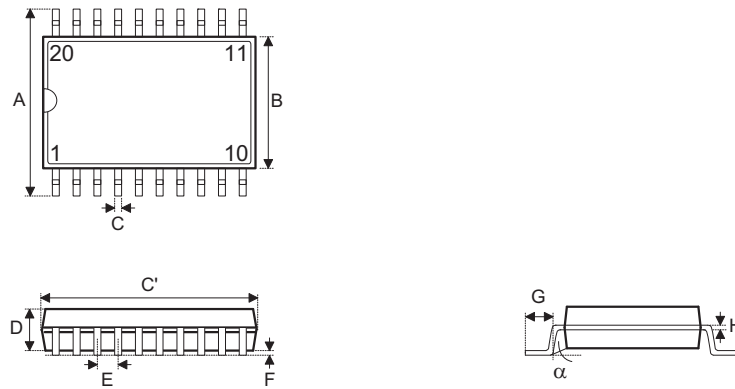
20-pin SOP (300mil) Outline Dimensions



• MS-013

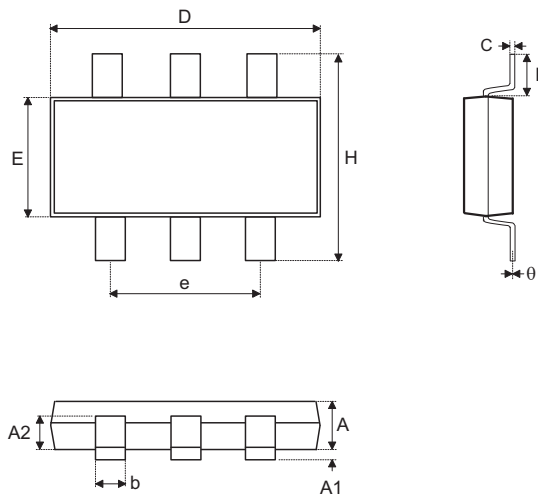
Symbol	Dimensions in mil		
	Min.	Nom.	Max.
A	393	—	419
B	256	—	300
C	12	—	20
C'	496	—	512
D	—	—	104
E	—	50	—
F	4	—	12
G	16	—	50
H	8	—	13
α	0°	—	8°

20-pin SSOP (150mil) Outline Dimensions

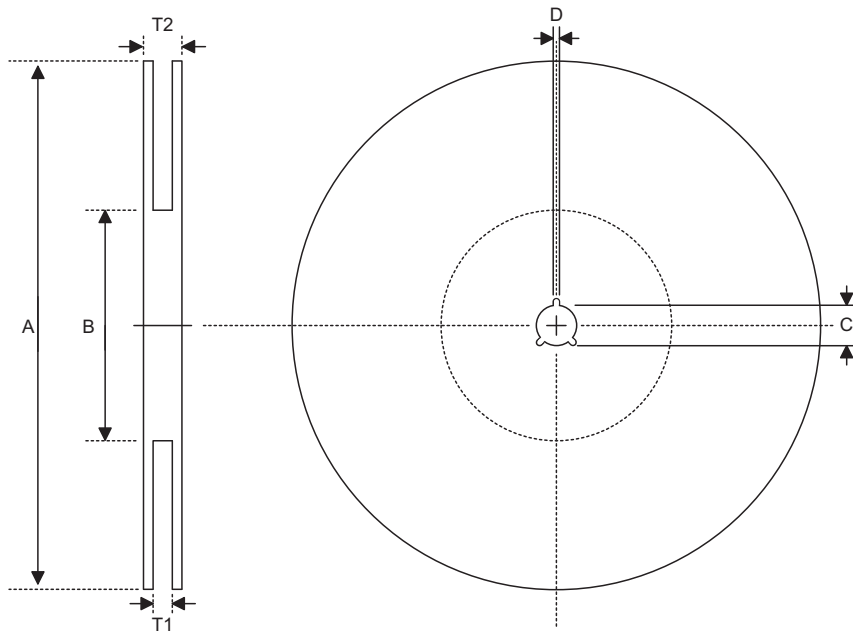


Symbol	Dimensions in mil		
	Min.	Nom.	Max.
A	228	—	244
B	150	—	158
C	8	—	12
C'	335	—	347
D	49	—	65
E	—	25	—
F	4	—	10
G	15	—	50
H	7	—	10
α	0°	—	8°

6-pin SOT23-6 Outline Dimensions



Symbol	Dimensions in mm		
	Min.	Nom.	Max.
A	1.0	—	1.3
A1	—	—	0.1
A2	0.7	—	0.9
b	0.35	—	0.50
C	0.1	—	0.25
D	2.7	—	3.1
E	1.4	—	1.8
e	—	1.9	—
H	2.6	—	3.0
L	0.37	—	—
θ	1°	—	9°

Product Tape and Reel Specifications
Reel Dimensions

SOP 8N

Symbol	Description	Dimensions in mm
A	Reel Outer Diameter	330.0±1.0
B	Reel Inner Diameter	100.0±1.5
C	Spindle Hole Diameter	13.0 ^{+0.5/-0.2}
D	Key Slit Width	2.0±0.5
T1	Space Between Flange	12.8 ^{+0.3/-0.2}
T2	Reel Thickness	18.2±0.2

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SOP 16N (150mil)

Symbol	Description	Dimensions in mm
A	Reel Outer Diameter	330.0±1.0
B	Reel Inner Diameter	100.0±1.5
C	Spindle Hole Diameter	13.0 ^{+0.5/-0.2}
D	Key Slit Width	2.0±0.5
T1	Space Between Flange	16.8 ^{+0.3/-0.2}
T2	Reel Thickness	22.2±0.2

SOP 20W

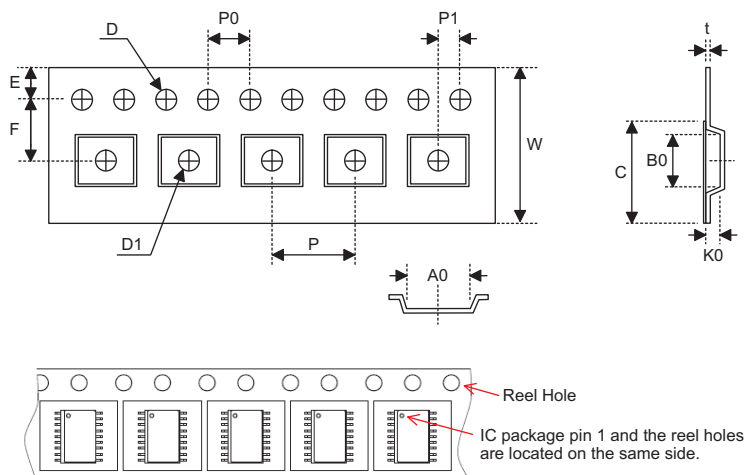
Symbol	Description	Dimensions in mm
A	Reel Outer Diameter	330.0±1.0
B	Reel Inner Diameter	100.0±1.5
C	Spindle Hole Diameter	13.0 ^{+0.5/-0.2}
D	Key Slit Width	2.0±0.5
T1	Space Between Flange	24.8 ^{+0.3/-0.2}
T2	Reel Thickness	30.2±0.2

SSOP 20S (150mil)

Symbol	Description	Dimensions in mm
A	Reel Outer Diameter	330.0±1.0
B	Reel Inner Diameter	100.0±1.5
C	Spindle Hole Diameter	13.0 ^{+0.5/-0.2}
D	Key Slit Width	2.0±0.5
T1	Space Between Flange	16.8 ^{+0.3/-0.2}
T2	Reel Thickness	22.2±0.2

SOT23-6

Symbol	Description	Dimensions in mm
A	Reel Outer Diameter	178.0±1.0
B	Reel Inner Diameter	62.0±1.0
C	Spindle Hole Diameter	13.0±0.2
D	Key Slit Width	2.50±0.25
T1	Space Between Flange	8.4 ^{+1.5/-0.0}
T2	Reel Thickness	11.4 ^{+1.5/-0.0}

Carrier Tape Dimensions

SOP 8N

Symbol	Description	Dimensions in mm
W	Carrier Tape Width	12.0 ^{+0.3/-0.1}
P	Cavity Pitch	8.0±0.1
E	Perforation Position	1.75±0.1
F	Cavity to Perforation (Width Direction)	5.5±0.1
D	Perforation Diameter	1.55±0.1
D1	Cavity Hole Diameter	1.50 ^{+0.25/-0.00}
P0	Perforation Pitch	4.0±0.1
P1	Cavity to Perforation (Length Direction)	2.0±0.1
A0	Cavity Length	6.4±0.1
B0	Cavity Width	5.2±0.1
K0	Cavity Depth	2.1±0.1
t	Carrier Tape Thickness	0.30±0.05
C	Cover Tape Width	9.3±0.1

SOP 16N (150mil)

Symbol	Description	Dimensions in mm
W	Carrier Tape Width	16.0±0.3
P	Cavity Pitch	8.0±0.1
E	Perforation Position	1.75±0.1
F	Cavity to Perforation (Width Direction)	7.5±0.1
D	Perforation Diameter	1.55 ^{+0.10/-0.00}
D1	Cavity Hole Diameter	1.50 ^{+0.25/-0.00}
P0	Perforation Pitch	4.0±0.1
P1	Cavity to Perforation (Length Direction)	2.0±0.1
A0	Cavity Length	6.5±0.1
B0	Cavity Width	10.3±0.1
K0	Cavity Depth	2.1±0.1
t	Carrier Tape Thickness	0.30±0.05
C	Cover Tape Width	13.3±0.1

SOP 20W

Symbol	Description	Dimensions in mm
W	Carrier Tape Width	24.0 ^{+0.3/-0.1}
P	Cavity Pitch	12.0±0.1
E	Perforation Position	1.75±0.10
F	Cavity to Perforation (Width Direction)	11.5±0.1
D	Perforation Diameter	1.5 ^{+0.1/-0.0}
D1	Cavity Hole Diameter	1.50 ^{+0.25/-0.00}
P0	Perforation Pitch	4.0±0.1
P1	Cavity to Perforation (Length Direction)	2.0±0.1
A0	Cavity Length	10.8±0.1
B0	Cavity Width	13.3±0.1
K0	Cavity Depth	3.2±0.1
t	Carrier Tape Thickness	0.30±0.05
C	Cover Tape Width	21.3±0.1

SSOP 20S (150mil)

Symbol	Description	Dimensions in mm
W	Carrier Tape Width	16.0 ^{+0.3/-0.1}
P	Cavity Pitch	8.0±0.1
E	Perforation Position	1.75±0.10
F	Cavity to Perforation (Width Direction)	7.5±0.1
D	Perforation Diameter	1.5 ^{+0.1/-0.0}
D1	Cavity Hole Diameter	1.50 ^{+0.25/-0.00}
P0	Perforation Pitch	4.0±0.1
P1	Cavity to Perforation (Length Direction)	2.0±0.1
A0	Cavity Length	6.5±0.1
B0	Cavity Width	9.0±0.1
K0	Cavity Depth	2.3±0.1
t	Carrier Tape Thickness	0.30±0.05
C	Cover Tape Width	13.3±0.1

SOT23-6

Symbol	Description	Dimensions in mm
W	Carrier Tape Width	8.0±0.3
P	Cavity Pitch	4.0±0.1
E	Perforation Position	1.75±0.10
F	Cavity to Perforation (Width Direction)	3.50±0.05
D	Perforation Diameter	1.5 ^{+0.1/-0.0}
D1	Cavity Hole Diameter	1.5 ^{+0.1/-0.0}
P0	Perforation Pitch	4.0±0.1
P1	Cavity to Perforation (Length Direction)	2.00±0.05
A0	Cavity Length	3.15±0.10
B0	Cavity Width	3.2±0.1
K0	Cavity Depth	1.4±0.1
t	Carrier Tape Thickness	0.20±0.03
C	Cover Tape Width	5.3±0.1

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