alsentis

HSS™ Touch Signature IC BASIC 1-6 Input - I²C

A0021

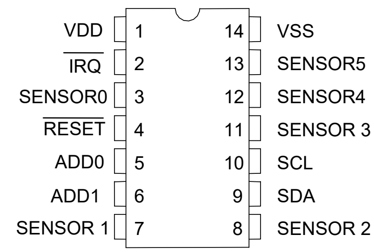
Overview

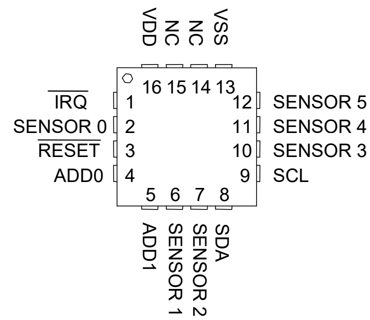
The patented ***AlSentis***® A0021 Touch IC is a complete BASIC 1 – 6 input touch sensing solution. It includes all signal processing functions necessary to provide robust sensing under a wide variety of changing conditions. Only minimal, low cost components are required for standard operation.

The ***AlSentis***® touch sensing solution differentiates itself from capacitive sensors by measuring the actual touch event signature versus relying on comparisons of measured signals to predetermined thresholds; providing a reliable solution for your touch application. By measuring the signature of a touch event in combination with ***AlSentis***® proprietary electrode geometries, potential interference from EMI, moisture and surface contaminants is eliminated. Another benefit of measuring the signature of the touch event is the ability to distinguish between a glove touch and a "bare finger" touch while giving the user the same feel of sensitivity.

Communication with the A0021 IC is provided via I²C protocol. Individual and multiple sensor scans can be requested as well as device status, and configuration.

The A0021 ASIC is very easy to integrate into products by reducing the amount up-front engineering normally required for implementing capacitive solutions which reduces your time to market and development costs.





Features

- Complete BASIC 1-6 input Touch Solution
- Patented HSS™ Touch Signature Recognition
- I²C Communication
- 20uA quiescent current (Hibernate Mode)
- Electrodes can be made from etched copper, printed silver, Indium Tin Oxide (ITO) and more.
- Electrode substrates can be PCB, Flex PCB, PET, Polyimide, Polycarbonate, and glass.
- Touch surface substrates can be glass, plastic, composites, wood, leather, fabric, and other non-conductive materials.

Ordering Information

Part Number Format: A0021 000 X Y Z

Z: Packaging **Q** = 16 Pin QFN, **T** = 14 Pin TSSOP, **S** = 14 Pin SOIC

Y: Temperature Range **1**= -40C — +85C, **2** = -40C — 105C

X: Application **A** = Automotive, **C** = Consumer/Industrial

Electrical Characteristics

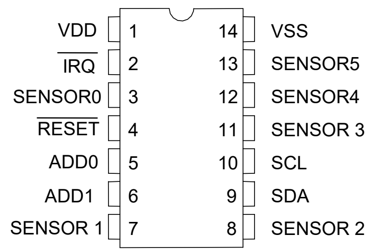
Absolute Maximum Ratings

Designation	Item	Condition	Rated Value	Unit
Tamb	Ambient Temperature		-40 — +125	°C
T_{stg}	Storage Temperature		-65 — +150	°C
V_{dd}	Supply Voltage	Voltage on V_{dd} with respect to V_{ss}	-0.3 — 5.5	V
I_{IRQ}	IRQ line current	Sinking	10	mA

Operating Conditions

Designation	Item	Condition	Rated Value			Unit
			Min	Nom	Max	
	Supply Voltage = 5Vdc					
V_{dd}	Supply Voltage	+/-5%	4.75	5.0	5.25	V
I_{dd}	Supply Current (Run mode)		-	3.51	5.13	mA
	Supply Current (Hibernate mode)		-	21.7	65	µA
V_{rl}	Reset Low Voltage	0.2*Vdd	0.95	1.0	1.05	V
V_{rh}	Rest High Voltage	0.8*Vdd	3.8	4.0	4.2	V
IRQ_l	IRQ Low voltage		-	-	0.6	V
	Supply Voltage = 3.3Vdc					
V_{dd}	Supply Voltage	+/-5%	3.135	3.3	3.465	V
I_{dd}	Supply Current (Run mode)		-	3.31	4.61	mA
	Supply Current (Hibernate mode)		-	20.5	48	µA
V_{rl}	Reset low Voltage	0.2*Vdd	0.627	0.660	0.693	V
V_{rh}	Rest High Voltage	0.8*Vdd	2.508	2.64	2.772	V
IRQ_l	IRQ Low voltage		-	-	0.6	V
	Common					
T_{rst}	Reset Low pulse width Timing		2	-	-	ms
$T_{startup}$	Time before IC is ready for Config.	First Time power up	40	70	140	ms
	Touch Response	Run mode		40		ms
	Touch Response	From hibernate mode		70		ms

14 Pin Diagram

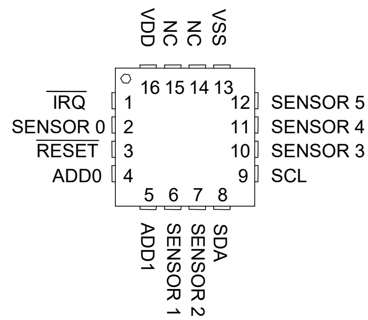


Pin	Name	Function	Description / Connection
1	VDD	Power	Supply Voltage
2	$\overline{\text{IRQ}}$	Open Collector Output	Data Ready signal line [3]
3	Sensor 0	Touch Sensor Input	Connect to Sensor 0 Electrode [1]
4	$\overline{\text{Reset}}$	Input	Allows for manual reset of ASIC [3]
5	ADD0	Digital Input	I^2C Device Address Bit 0 [2]
6	ADD1	Digital Input	I^2C Device Address Bit 1 [2]
7	Sensor 1	Touch Sensor Input	Connect to Sensor 1 Electrode [1]
8	Sensor 2	Touch Sensor Input	Connect to Sensor 2 Electrode [1]
9	SDA	Communication	I^2C Data Bus
10	SCL	Communication	I^2C Clock Bus
11	Sensor 3	Touch Sensor Input	Connect to Sensor 3 Electrode [1]
12	Sensor 4	Touch Sensor Input	Connect to Sensor 4 Electrode [1]
13	Sensor 5	Touch Sensor Input	Connect to Sensor 5 Electrode [1]
14	VSS	Power	Ground connection

Note:

1. 1 - 10kohm in series resistor required on all Sensor pins (See Application Example for Specific Details).
2. These pins are used to configure the 2 least significant bits of the ASIC's device slave address for I^2C communication protocol.
3. See application example for specific details

16 Pin Diagram



Pin	Name	Function	Description / Connection
1	$\overline{\text{IRQ}}$	Open Collector Output	Data Ready signal line [3]
2	Sensor 0	Touch Sensor Input	Connect to Sensor 0 Electrode [1]
3	$\overline{\text{Reset}}$	Input	Allows for manual reset of ASIC [3]
4	ADD0	Digital Input	I^{2}C Device Address Bit 0 [2]
5	ADD1	Digital Input	I^{2}C Device Address Bit 1 [2]
6	Sensor 1	Touch Sensor Input	Connect to Sensor 1 Electrode [1]
7	Sensor 2	Touch Sensor Input	Connect to Sensor 2 Electrode [1]
8	SDA	Touch Sensor Input	I^{2}C Data Bus
9	SCL	Communication	I^{2}C Clock Bus
10	Sensor 3	Communication	Connect to Sensor 3 Electrode [1]
11	Sensor 4	Touch Sensor Input	Connect to Sensor 4 Electrode [1]
12	Sensor 5	Touch Sensor Input	Connect to Sensor 5 Electrode [1]
13	VSS	Power	Ground connection
14	NC		Unused pin — Do not connect
15	NC		Unused pin — Do not connect
16	VDD	Power	Supply Voltage

Note:

1. 1k - 10kohm in series resistor required on all Sensor pins (See Application Example for Specific Details).
2. These pins are used to configure the 3 least significant bits of the ASIC's device slave address for I^{2}C communication protocol.
3. See application example for specific details

Application Information

Block Diagram

Figure 1 shows a block diagram highlighting the inputs and outputs for a standard 6 input design. Typical electrodes for a touch input design can be made by creating a 14mm diameter solid copper pad on your circuit board layout. The PCB track connecting the electrode to the IC should be as thin and short as possible. Typical trace width being 10mils. (Please refer to our application notes for more information regarding electrode and substrate design.) The electrodes are connected to the A0021 through series resistors with values ranging from 1k—10k ohm. Place the resistors as close to the IC as possible. Communication to the A0021 is accomplished through a standard master slave protocol with a 7 bit address.

Set the address by connecting the ADD0—ADD1 lines to either GND or VDD to create a unique address for each IC in the system. The IRQ line serves as an interrupt to the Host micro when the IC needs to be configured or when a touch/release signature occurs.

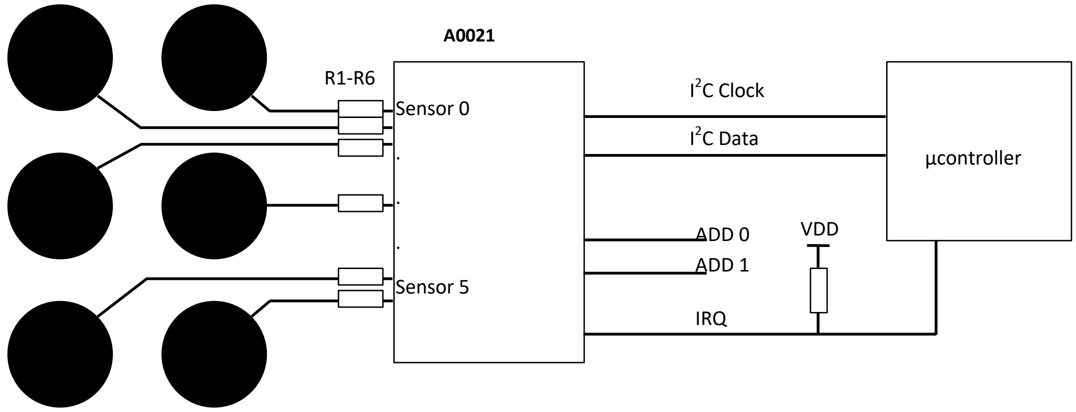


Figure 1

Reference Schematic

Figure 2 shows a complete reference schematic. Always use engineering best practices with design and layout of your A0021 circuit. Place decoupling capacitors close to the IC. Place the RC reset circuit close to pin 4 for a clean reset on power up. Place the series sensor resistors as close to the IC as possible for input transient protection. Place the I^2C pull-up resistors close to the first receiver when using more than 1 receiver on the bus.

Please refer to the latest I^2C specification for further clarification. The routing for the sensor electrodes should be as clean and direct as possible. Keep the ground and power plane from routing under the sensor lines and electrodes. When on the same layer, keep the ground plane back at least 1.3mm however this dimension can change depending on system requirements.

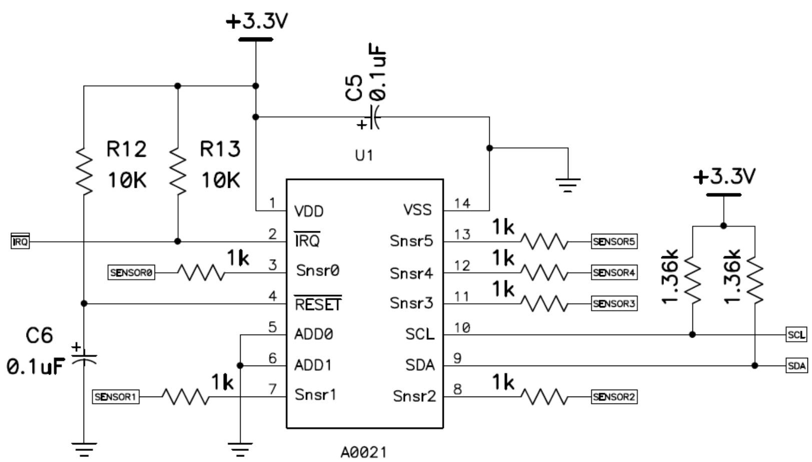


Figure 2

I²C Commands

Addressing

The A0021 communicates on the I²C protocol. Addressing for this IC is done so using a 7-Bit addressing scheme. The first byte after the START condition is the Slave address. This determines which slave IC is selected by the master. The least significant bit indicates the data direction. A 1 in the least significant bit means the master will read information from the slave. A 0 in this bit position means the master will write information to the slave. The R/W bit is shown in Figure 3. When the START condition and address is sent, each device in the system compares the upper 7 bits with its address. When a match occurs, the IC considers itself address by the master.

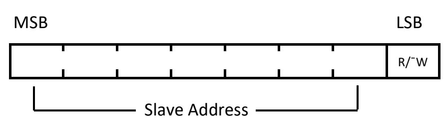


Figure 3

The upper half of the address byte is fixed to 0xBX. The address is unique to each IC then by wiring the address lines to either GND or VCC. The combination of the fixed address, address lines and the R/W bit is shown in Figure 4.

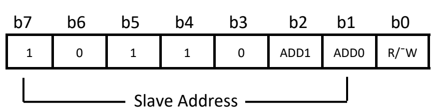


Figure 4

The table shown at Figure 5 demonstrates the possible address values based on the above information.

	b7	b6	b5	b4	b3	b2	b1	b0
Value	1	0	1	1	0	ADD1	ADD0	R/W
0XB0	1	0	1	1	0	0	0	X
0xB2	1	0	1	1	0	0	1	X
0xB4	1	0	1	1	0	1	0	X
0xB6	1	0	1	1	0	1	1	X

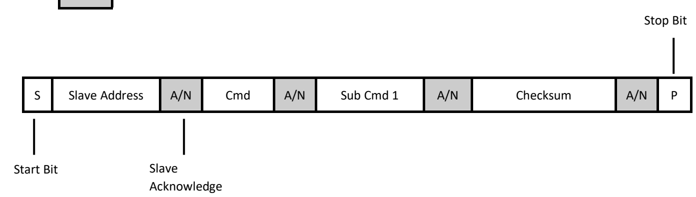
Figure 5

Message Structure

The I²C message structure for the A0021 is as follows.

S	Start condition sent by the Master
A/N	Acknowledge or Not Acknowledge
RS	RESTART condition sent by the Master to signal sending or receiving data
P	Stop bit sent by the Master

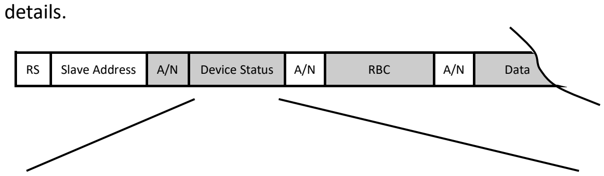
(white)	A white box indicates communication sent by the Master
(grey)	A grey box indicates communication sent by the Slave



The checksum can be omitted or ignored if the use of a checksum is not desired. Calculation of the checksum is done by performing an 8-bit addition of all bytes transmitted after the device address byte. If the above message was: Slave Address 0xB2; Cmd 0x0A; Sub Cmd 1 0x03, the Checksum would be : (0x0A + 0x03) = 0x0D.

Device Status Byte

For any message that has return data from the Slave, the Master sends a RESTART followed by the Slave address. The Slave will then send an acknowledge followed by a Device Status byte. The definition of the device status bits are shown below. Data after the Device Status byte depends on the command. Please see the I²C commands for further details.



Device Status Byte							
Error Code				Device State			
b7	b6	b5	b4	b3	b2	b1	b0

Error Code: < B7 : B4 >	**Device State: < B3 : B0 >**
0 : No Error	1 : Ready and monitoring sensors
1 : Checksum mismatch	2 : Waiting for configuration
2 : Unknown command	3 : Configuring
3 : Command format error	4 : Initializing
4 : Command not allowed	5 : Hibernating
5 : DOT error	6 : Diagnostic
	7 : Discover Optimal TRZ (DOT)

Clock Stretching

The A0021 utilizes bit stretching so to give priority to the HSS signature recognition.

Command Set

The A0021 consists of 13 commands shown in the table below.

	I2C Command (Cmd)	Value	Description
1	Write Configuration	0x0A	Sets the number of active sensors
2	Read Configuration	0x8A	Returns the current active sensors
3	Set Sensor TRZ	0x0B	Sets the TRZ value for each sensor
4	Read Sensor TRZ	0x8B	Returns the TRZ value for each sensor
5	Write Latch-up Timeout Value	0x0C	Sets the time to wait before releasing button that has been in the Touch State
6	Read Latch-up Timeout Value	0x8C	Reads the time that has been stored for the Latch-up Timeout value
7	Write BounceBack Adjust Value	0x0D	Sets the time to allow a fast adjust to a No Touch after an initialization
8	Read BounceBack Adjust Value	0x8D	Reads the time to allow a fast adjust to a No Touch after an initialization
9	Read Sensors State	0x9F	Returns the bitwise state of each sensor
10	Read Device Status	0x9E	Returns the Status of the IC
11	Clear Device Errors	0x1E	Clears any error codes previously set
12	Set Hibernate State	0x14	Causes IC to Enter or Exit hibernate mode
13	Reset	0x52	Resets the IC to State 1

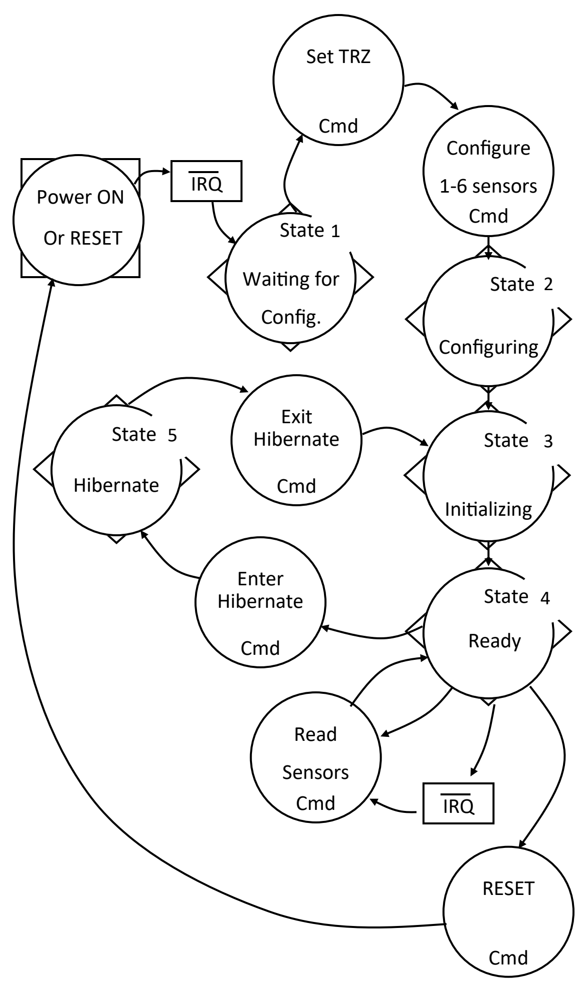
Operating States

State #	State	Description
1	Waiting For Configuration	Sensors are not monitored and the device is Idle
2	Configuring	Device enables sensors as dictated by the I^2C master
3	Initializing	All enabled sensors are initializing the No-Touch state
4	Ready	All enabled sensors are being scanned for a touch signature
5	Hibernate	No sensors are scanned, device is in low current hibernate mode

Startup Sequence

At the initial power up condition, hardware RESET condition, or software RESET Command, the A0021 will pull the IRQ line low, reset, and be in the Waiting For Configuration State. At this time the Master can set the TRZ value for any or all sensors. After the TRZ values have been established, the command to Configure Sensors should be sent to enable the sensors according to the design. From here the device will go through the Configuring State and Initializing State. Now the A0021 is in the Ready State and monitoring all enabled sensors. From this State, the Read Sensor command can be issued to verify the Touch or No Touch condition of each enabled sensor. Alternatively you may wait for the IRQ line to be pulled low when a sensor is touched or removed from a touch.

Basic Operation Flow



I²C: Write Configuration 0x0A

S	Slave Address	A/N	Cmd	A/N	Sub Cmd 1	A/N	Checksum	A/N	P

Byte	Contents	Limits	Description
Cmd	0x0A		Command for declaring the number of sensors to be used.
Sub Cmd 1	Sensor Enable Mask	0x00	The Sensor Enable Mask is a bitwise enable of each sensor. A value of 0 will disable a sensor. A value of 1 will enable the sensor.
		0x3F	The value of 0x3F will enable all 6 sensors.

After the IC has been reset through either the hardware reset or I²C reset message, it will be in the "Waiting For Configuration" state. At this time the IC will not monitor any electrodes. After the Set TRZ Command, the next message that should be sent is the Write Configuration command. This command combined with the sensor mask will enable any or all sensors by setting its corresponding bit position to a high level. After the IC has been initialized. It will change to the "Configuring" state before quickly changing to the "Initializing" state and finally to the "Ready" state within 50-55ms. At this time the IC will monitor only the sensors that are enabled. All other sensors will read as "not touched".

I²C: Read Configuration 0x8A

S	Slave Address	A/N	Cmd	A/N	Checksum	A/N	RS	Slave Address	A/N	Device Status	A/N	RBC	A/N	Data	A/N	Checksum	A/N	P

Byte	Contents	Limits	Description
Cmd	0x8A		Command for reading the configuration of the sensors. Either 0 for disabled or 1 for enabled.
Device Status			See the description on Page 6.
RBC	Return Data Byte Count	1	RBC is the number of data bytes that the device will return. This device will always return a 1 in RBC for this message.
Data	Bitwise value of the sensor configuration	0x00 - 0x3F	0 - disabled 1 - Enabled

The Read Configuration command reports the status of which sensors are enabled. After the Master sends the command, an RS is issued and the Slave will report the Device Status, a return byte of 1, and the bitwise condition of each sensor. The bit will be 0 if the sensor is disabled, and a 1 if the sensor is enabled. See the table below for further explanation.

Sensor Enable Mask

For the Write and Read Configuration commands, the sensors are enabled or disabled by these bitwise locations. A value of 0x11 in the mask means that Sensor 4 and 0 are enabled. B7-B6 are ignored by the slave.

	Sensor Enable Mask							
	b7	b6	b5	b4	b3	b2	b1	b0
Sensor	NA	NA	Sensor 5	Sensor 4	Sensor 3	Sensor 2	Sensor 1	Sensor 0

I²C: Set Sensor TRZ 0x0B

S	Slave Address	A/N	Cmd	A/N	Sub Cmd 1	A/N	Sub Cmd 2	A/N	Data	A/N	. . .	Data	A/N	Checksum	A/N	P

Data Transferred

(n bytes equal to Sensor Count)

Byte	Contents	Limits	Description
Cmd	0x0B		Command for setting the TRZ value for 1 or more sensors
Sub Cmd 1	Sensor Count	1 - 6	Holds the number of sensors that will receive a new TRZ value
Sub Cmd 2	Start Sensor #	0 - 5	Holds the starting sensor number to be initialized
		0xFF	By placing a 0xFF in the start sensor #, all sensors will be set with the same TRZ value located in the first Data byte
Data[0] , Data[1]…	TRZ Value	0x00 - 0x3F	The TRZ value is sent consecutively for each sensor

The Outer Zone is the distance from the electrode dictating when the IC starts to monitor the electric field variations for a touch signature event. The larger the Outer Zone number, the further away from the electrode HSS™ will start to look for touch signatures. This is useful when using HSS™ to sense through thicker plastics. The Outer Zone number is in the upper nibble of Data Byte. Shown below.

Higher Outer Zone

Outer Zone				Inner Zone			
b7	b6	b5	b4	b3	b2	b1	b0
x	x	x	x				
x	x	x	x				
0	0	1	1				
0	0	1	0				
0	0	0	1				
0	0	0	0				

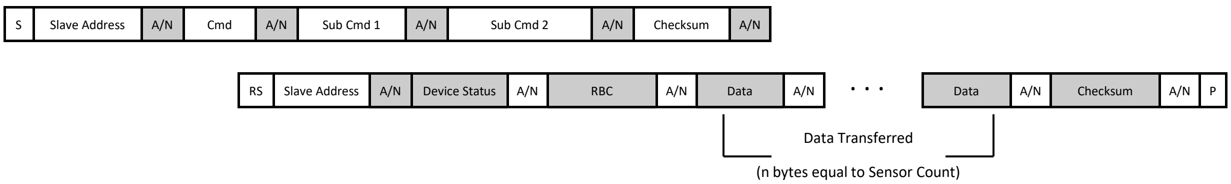
Changing the Inner Zone value will set the area above the sensor that the Touch Signature event must end within. These 2 parameters are used in conjunction. When a finger approaches an electrode, HSS™ starts to evaluate it for a Touch Signature after the finger enters the Outer Zone. If the Finger continues through the Outer Zone and into the Inner Zone and completes a Touch Signature inside of the Inner Zone, HSS™ will report that a valid touch has occurred. Combining these 2 parameters results achieving a consistent touch performance through even thick plastics or glass.

Outer Zone				Inner Zone			
b7	b6	b5	b4	b3	b2	b1	b0
				1	1	1	1
				1	1	1	0
				0	0	0	1
				0	0	0	0

Higher Inner Zone

The TRZ value can be set for each individual sensor by setting the sensor count to 1 and the start sensor to the specific sensor of interest. Alternately, by setting the start sensor number to 0xFF, all sensors can be set to the same TRZ value. This is useful to limit the communication time if all sensors have the same TRZ however in most practical designs, the TRZ will differ from electrode to electrode based on factors such as parasitic capacitances from PCB traces to each electrode.

I^{2}C: Read Sensor TRZ 0x8B



Byte	Contents	Limits	Description
Cmd	0x8B		Command for reading the TRZ value for 1 or more sensors.
Sub Cmd 1	Sensor Count	1 - 6	Holds the number of sensors that will return their TRZ value to the Master.
Sub Cmd 2	Start Sensor #	0 - 5	Holds the starting sensor number to be read.
Device Status			See the description on Page 6.
RBC	Return Byte Count	1-6	Each TRZ is 1 byte in length. The return byte count will be the same as sensor count.
Data[0] , Data[1]…	TRZ Value	0x00 - 0x3F	The TRZ value is sent consecutively for each sensor.

The Read TRZ command allows for verification of the TRZ values previously set by the Write TRZ command. After the Master sends the Command and Sub Commands, an RS is issued and the Slave will report the Device Status, a return byte count which will be the number of sensors that the TRZ value will correspond to. The protocol for reading individual or sensors is the same for the Read command as it is for the Write command.

I^2C: Write Latch-up Timeout 0x0C

S	Slave Address	A/N	Cmd	A/N	Sub Cmd 1	A/N	Checksum	A/N	P

Byte	Contents	Limits	Description
Cmd	0x0C		Command for setting the time to wait before releasing button that has been in the Touch State.
Sub Cmd 1	Timeout Value	0x00	A value of 0x00 will turn off the Latch-up timeout feature.
		0xFF	The value of 0x01—0xFF will set the Latch-up timeout value from 1 to 255 seconds. The Default value is set to 0xFA (250 seconds).

The Latch-up timeout command establishes the duration of time that the IC must wait before considering that a continuous button press is latched on for any reason. When this time expires, the IC will pull the IRQ line low to signal a change in data to button off and re-calibrate the No-Touch State of the button. Sending a 0x00 in Sub Cmd 1 location will turn off the Latch-up timer so that a re-calibration will never occur. A 0xFF results in 255 seconds. If the command is sent while the button is pressed, and the timeout value is greater than the time the button has been pressed, the button will be released at the end of the timeout. If the command is sent while the button is pressed but the timeout value is less than the time the button has been currently pressed, the button will be released immediately.

I^2C: Read Latch-up Timeout 0x8C

S	Slave Address	A/N	Cmd	A/N	Checksum	A/N	RS	Slave Address	A/N	Device Status	A/N	RBC	A/N	Data	A/N	Checksum	A/N	P

Byte	Contents	Limits	Description
Cmd	0x8C		Command for reading the Latch-up timeout value.
Device Status			See the description on Page 6.
RBC	Return Data Byte Count	1	RBC is the number of data bytes that the device will return. This device will always return a 1 in RBC for this message.
Data	Timeout Value	0x00 - 0xFF	The value of 0x01—0xFF will the Latch-up timeout value from 1 to 255 seconds.

The Read Latch-up timeout command reports the time duration stored from the Write Command. After the Master sends the Command, an RS is issued and the Slave will report the Device Status, a return byte count of 1 and the Latch-up Timeout value.

I²C: Write BounceBack Timeout 0x0D

S	Slave Address	A/N	Cmd	A/N	Sub Cmd 1	A/N	Checksum	A/N	P

Byte	Contents	Limits	Description
Cmd	0x0D		Sets the time to allow a fast adjust to a No Touch after an initialization.
Sub Cmd 1	Timeout Value	0x00	A value of 0x00 turns the BounceBack Timer off so that adjustments are made at the normal rate.
		0x01 - 0x1E	The value of 0x01—0x1E (30dec) will set the Bounce-Back timeout value from 1 to 30 seconds. The Default value is set to 0x1E (30seconds).

The BounceBack Timeout is used to quickly adjust the No Touch calibration state after power up, reset, or sleep mode. The scenario may be that a touch is present at power up or before the IC wakes from sleep. During these conditions a No Touch calibration occurs. If a touch is present during this time it will be seen as a No Touch Condition. If BounceBack is enabled and the touch is removed within the BounceBack Timeout period, up to 30 seconds, HSS™ will quickly re-adjust the No Touch state and begin to recognize new touch signatures immediately. If BounceBack is not enabled, and the above condition occurs, new touch signatures may not be recognized for up to 30 seconds.

I²C: Read BounceBack Timeout 0x8D

S	Slave Address	A/N	Cmd	A/N	Checksum	A/N	RS	Slave Address	A/N	Device Status	A/N	RBC	A/N	Data	A/N	Checksum	A/N	P

Byte	Contents	Limits	Description
Cmd	0x8D		Command for reading the BounceBack Timeout value.
Device Status			See the description on Page 6.
RBC	Return Data Byte Count	1	RBC is the number of data bytes that the device will return. This device will always return a 1 in RBC for this message.
Data	Timeout Value	0x00—0x1E	The stored BounceBack timeout value will be from 0x00 (off) - 0x1E (30seconds).

The Read BounceBack timeout command reports the time duration stored from the Write Command. After the Master sends the Command, an RS is issued and the Slave will report the Device Status, a return byte count of 1 and the BounceBack Timeout value.

I²C: Read Sensor States 0x9F

S	Slave Address	A/N	Cmd	A/N	Checksum	A/N	RS	Slave Address	A/N	Device Status	A/N	RBC	A/N	Data	A/N	Checksum	A/N	P

Byte	Contents	Limits	Description
Cmd	0x9F		Command for reading the state of all sensors
Device Status			See the description on Page 6
RBC	Return Data Byte Count	1	RBC is the number of data bytes that the device will return. This device will always return a 1 in RBC for this message.
Data	Bitwise value of the sensors	0x00 - 0x3F	0 - Not Touched 1 - Touched

The Read Sensor States command is used to read the bitwise touch value of the sensors. For instance, when no sensor is touched, the Data byte will read 0x00. When sensor 2 is touched, the Data byte will read 0x04.

	Data byte							
	b7	**b6**	**b5**	**b4**	**b3**	**b2**	**b1**	**b0**
Sensor	NA	NA	Sensor 5	Sensor 4	Sensor 3	Sensor 2	Sensor 1	Sensor 0

I²C: Read Device Status 0x9E

S	Slave Address	A/N	Cmd	A/N	Checksum	A/N	RS	Slave Address	A/N	Device Status	A/N	RBC	A/N	Data	A/N	Checksum	A/N	P

Byte	Contents	Limits	Description
Cmd	0x9E		Command for reading the Device Status
Device Status			See the description on Page 6
RBC	Return Data Byte Count	1	RBC is the number of data bytes that the device will return. This device will always return a 1 in RBC for this message.
Data	Extended Status	0x00 - 0xFF	Equal to the command that caused the error.

The Read Device Status command is used to determine what state the IC is in and if there are any error codes. These are defined on page 6. If there is an error code present, the I²C command that caused the error will be placed the Extended Status byte.

I²C: Clear Device Errors 0x1E

S	Slave Address	A/N	Cmd	A/N	Sub Cmd 1	A/N	Checksum	A/N	P

Byte	Contents	Limits	Description
Cmd	0x1E		Command for Clearing any Device Errors
Sub Cmd 1	Clear Errors	0xFF	The Clear Error byte must contain a 0xFF for the device to clear errors.

Sending the Clear Device Errors command with a 0xFF will clear the upper nibble of the Device Status byte.

I^{2}C: Set Hibernate State 0x14

S	Slave Address	A/N	Cmd	A/N	Sub Cmd 1	A/N	Checksum	A/N	P

Byte	Contents	Limits	Description
Cmd	0x14		Command for setting the device to hibernate or awake
Sub Cmd 1	State	0x00	A 0 in the state byte sets the IC to the awake mode
		0x01	A 1 in the state byte sets the IC to the hibernate mode

The Hibernate command is used to place the device in a low power consumption hibernate state. This command can also set the device to resume normal operation. Sending this command with a 0x01 in the Sub Cmd 1 location will cause the IC to stop monitoring all sensors and go into a low power hibernate mode. During this time, all sensors will return the “not touched” condition. To resume normal operation and scan all active sensors, simply send the same command with a 0x00 in the Sub Cmd 1. When the IC receives the wake command, it will change to the “initializing device” state for 40ms before changing to the “ready” state.

I^{2}C: Reset 0x52

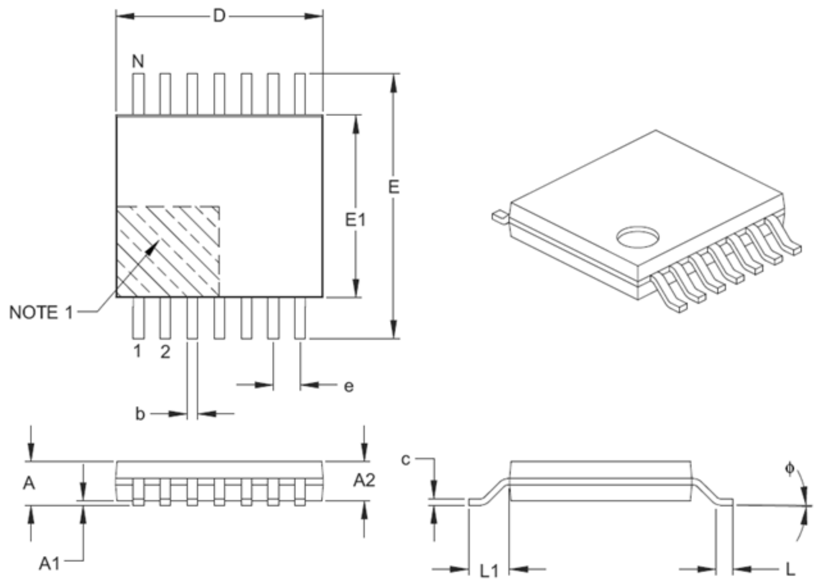
S	Slave Address	A/N	Cmd	A/N	Sub Cmd 1	A/N	Checksum	A/N	P

Byte	Contents	Limits	Description
Cmd	0x52		Command for resetting the device
Sub Cmd 1	Reset	0x00	A 0 in the Reset byte does nothing
		0x01	A 1 in the Reset byte causes the device to reset and waits in the “Waiting for Configuration” state

Sending the Reset command with a 0x01 will clear out all configuration including TRZ values. The IC will stop monitoring sensors and will be in the “Waiting For Configuration” state.

TSSOP Package Details

Typical 14-Lead Plastic Thin Shrink Small Outline—4.4mm Body [TSSOP]



	Units	MILLIMETERS		
	Dimension Limits	MIN	NOM	MAX
Number of Pins	N		14	
Pitch	e		0.65 BSC	
Overall Height	A	–	–	1.20
Molded Package Thickness	A2	0.80	1.00	1.05
Standoff	A1	0.05	–	0.15
Overall Width	E		6.40 BSC	
Molded Package Width	E1	4.30	4.40	4.50
Molded Package Length	D	4.90	5.00	5.10
Foot Length	L	0.45	0.60	0.75
Footprint	L1		1.00 REF	
Foot Angle	φ	0°	–	8°
Lead Thickness	c	0.09	–	0.20
Lead Width	b	0.19	–	0.30

Notes:

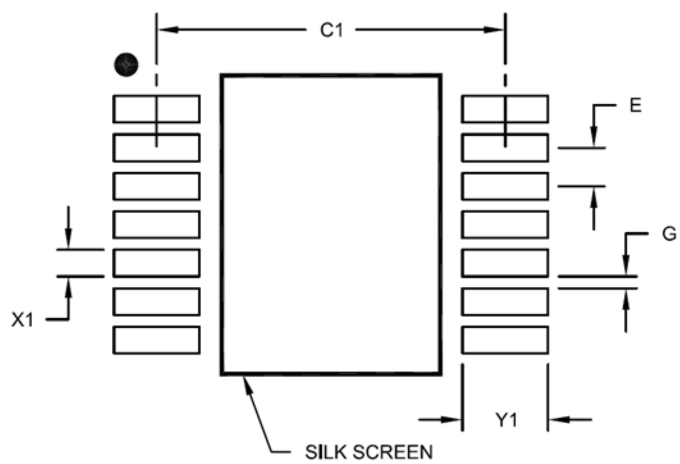
1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15 mm per side.
3. Dimensioning and tolerancing per ASME Y14.5M.

   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

   REF: Reference Dimension, usually without tolerance, for information purposes only.

TSSOP Recommended Land Pattern

Typical 14-Lead Plastic Thin Shrink Small Outline – 4.4 mm Body [TSSOP]



RECOMMENDED LAND PATTERN

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E	0.65 BSC		
Contact Pad Spacing	C1		5.90	
Contact Pad Width (X28)	X1			0.45
Contact Pad Length (X28)	Y1			1.45
Distance Between Pads	G	0.20		

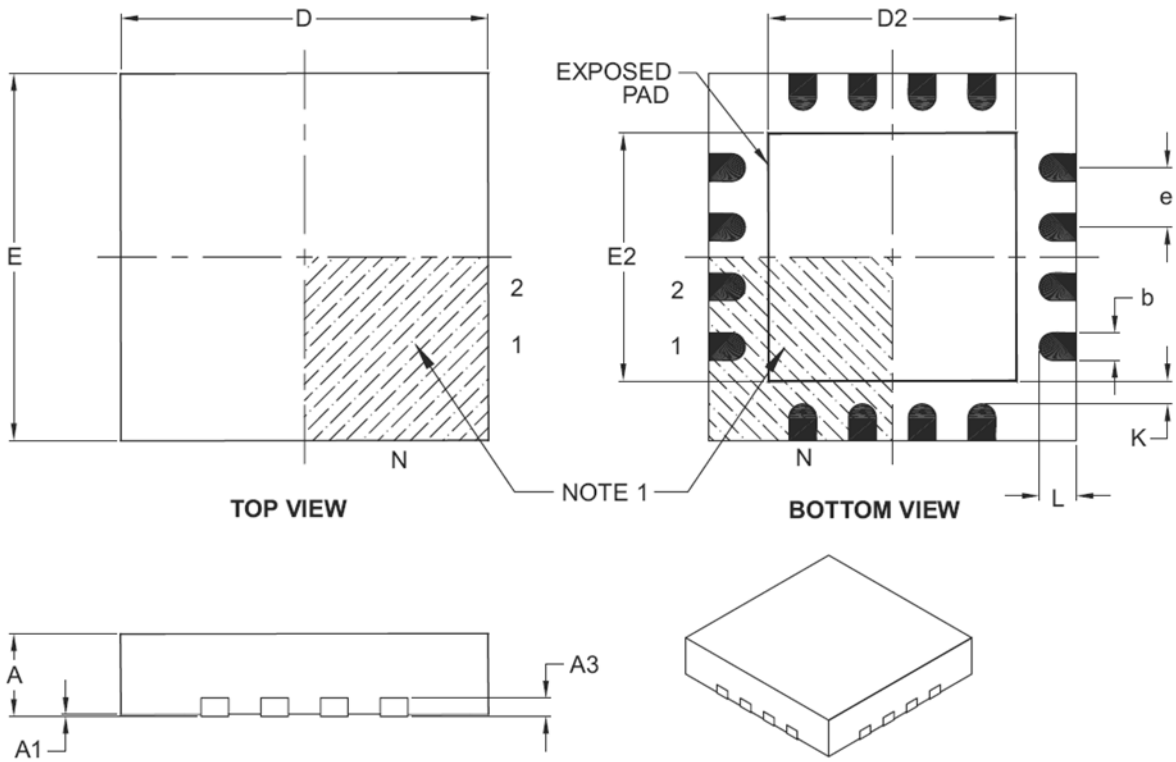
Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

QFN Package Details

Typical 16-Lead Plastic Quad Flat, No Lead Package – 4x4x0.9 mm Body [QFN]



Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N		16	
Pitch	e		0.65 BSC	
Overall Height	A	0.80	0.90	1.00
Standoff	A1	0.00	0.02	0.05
Contact Thickness	A3		0.20 REF	
Overall Width	E		4.00 BSC	
Exposed Pad Width	E2	2.50	2.65	2.80
Overall Length	D		4.00 BSC	
Exposed Pad Length	D2	2.50	2.65	2.80
Contact Width	b	0.25	0.30	0.35
Contact Length	L	0.30	0.40	0.50
Contact-to-Exposed Pad	K	0.20	–	–

Notes:

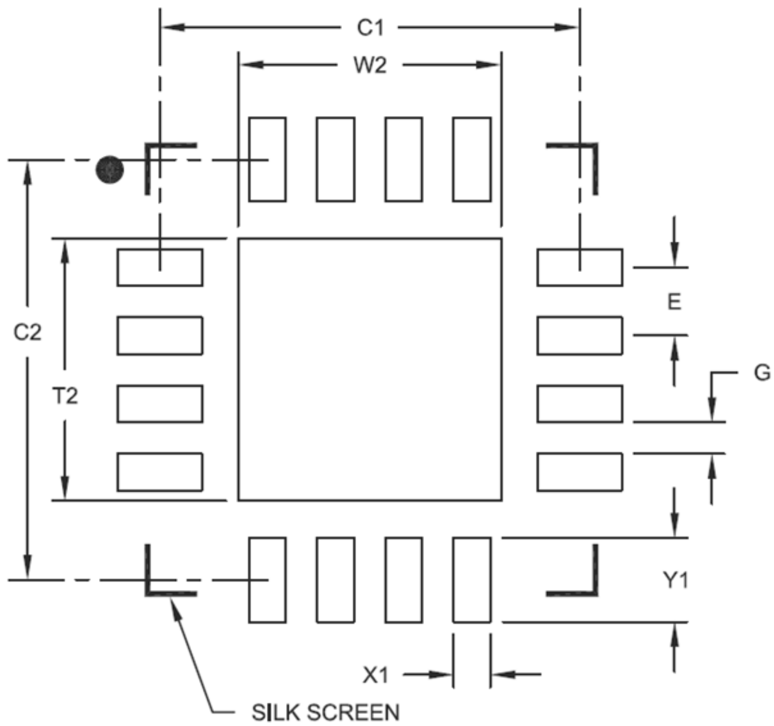
1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Package is saw singulated.
3. Dimensioning and tolerancing per ASME Y14.5M.

   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

   REF: Reference Dimension, usually without tolerance, for information purposes only.

QFN Recommended Land Pattern

Typical 16-Lead Plastic Quad Flat, No Lead Package – 4x4x0.9 mm Body [QFN]



RECOMMENDED LAND PATTERN

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E		0.65 BSC	
Optional Center Pad Width	W2			2.50
Optional Center Pad Length	T2			2.50
Contact Pad Spacing	C1		4.00	
Contact Pad Spacing	C2		4.00	
Contact Pad Width (X28)	X1			0.35
Contact Pad Length (X28)	Y1			0.80
Distance Between Pads	G	0.30		

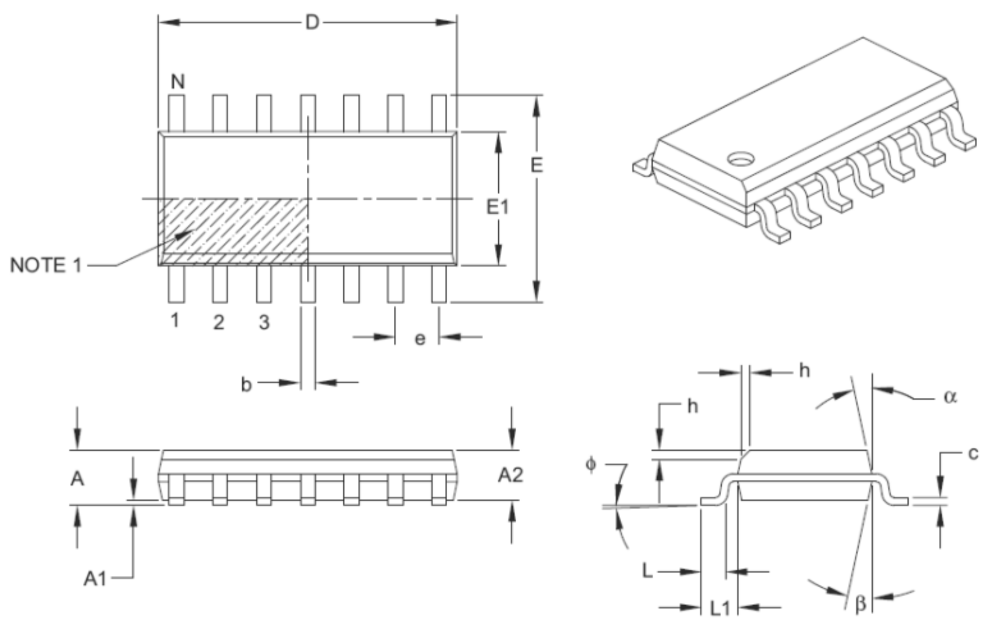
Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

SOIC Package Details

Typical 14-Lead Plastic Small Outline – Narrow, 3.90 mm Body [SOIC]



Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N		14	
Pitch	e		1.27 BSC	
Overall Height	A	–	–	1.75
Molded Package Thickness	A2	1.25	–	–
Standoff §	A1	0.10	–	0.25
Overall Width	E		6.00 BSC	
Molded Package Width	E1		3.90 BSC	
Overall Length	D		8.65 BSC	
Chamfer (optional)	h	0.25	–	0.50
Foot Length	L	0.40	–	1.27
Footprint	L1		1.04 REF	
Foot Angle	ϕ	0°	–	8°
Lead Thickness	c	0.17	–	0.25
Lead Width	b	0.31	–	0.51
Mold Draft Angle Top	α	5°	–	15°
Mold Draft Angle Bottom	β	5°	–	15°

Notes:

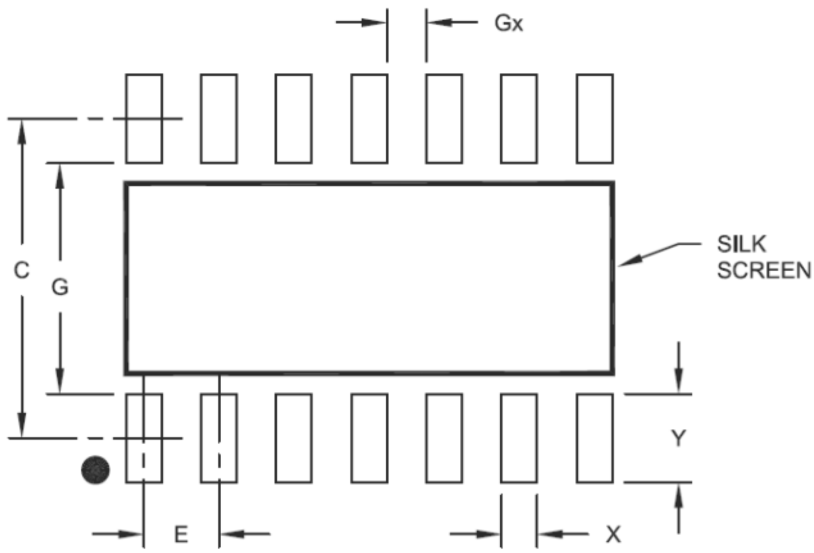
1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. § Significant Characteristic.
3. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15 mm per side.
4. Dimensioning and tolerancing per ASME Y14.5M.

   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

   REF: Reference Dimension, usually without tolerance, for information purposes only.

SOIC Recommended Land Pattern

Typical 14-Lead Plastic Small Outline – Narrow, 3.90 mm Body [SOIC]



RECOMMENDED LAND PATTERN

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Contact Pitch	E		1.27 BSC	
Contact Pad Spacing	C		5.40	
Contact Pad Width	X			0.60
Contact Pad Length	Y			1.50
Distance Between Pads	Gx	0.67		
Distance Between Pads	G	3.90		

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

   BSC: Basic Dimension. Theoretically exact value shown without tolerances.