

VN0001QIC01 simpletouch™ IC

14 Input Self Capacitance XY Touchscreen Controller

simpletouch™

Overview

The patented simpletouch™ IC is a single chip touch controller which requires no tuning. In addition to no tuning, the VN0001QIC01 IC offers performance features of working with glass (or equivalent substrate) with thicknesses from 0.5 mm to 2.0mm, works with water and glove, and can be configured with different X/Y electrode combinations and pixel ranges up to a maximum of 512. The VN0001QIC01 IC was designed with the wearable market as the primary target, but can be used in other markets as well.

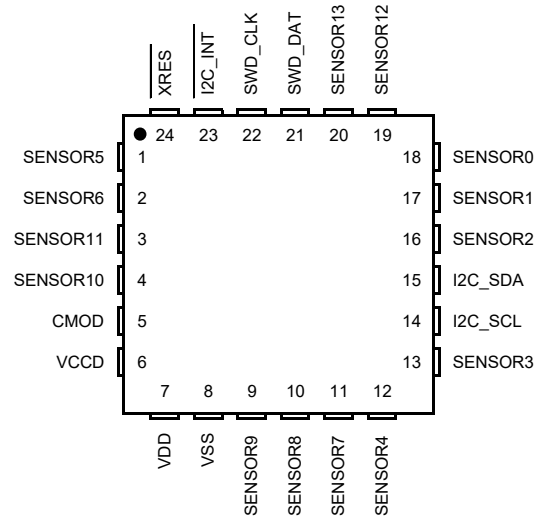
The communication interface to the VN0001QIC01 IC is via standard I²C bus. The VN0001QIC01 IC is configured as a slave device which communicates with a host I²C master controller. The configuration for the touch controller is performed by the host controller sending a command which will initiate the exchange to update the Control Register Structure for configuring the number of X electrodes, number of Y electrodes, X pixel range, and Y pixel range. Once the VN0001QIC01 IC is initialized, it will retain the initialization parameters in the Control Register Structure upon shut down and subsequent power ups.

Upon power up or reset, the VN0001QIC01 IC will initialize to the values last programmed into the simpletouch™ Control Register Structure. In the absence of programming the simpletouch™ Control Register Structure, the VN0001QIC01 IC will default to X Electrodes = 7, Y Electrodes = 7, X Pixel Range = 390, and Y Pixel Range = 390.

The VN0001QIC01 IC will currently only operate in self-capacitance mode and will output absolute X/Y data upon touch detection. The touch controller will power up into Monitor mode which actively scans the programmed X/Y electrodes. Upon detection of a touch, the touch controller will move into Active mode and generate an interrupt in which the host controller can read initiating the I²C communication protocol to transfer X/Y position data to the host controller. The X/Y data report rate to the host controller = 100hz. Upon the release of a detected touch, the touch controller will cease to output X/Y data and revert back into Monitor mode.

Features

- Patented simpletouch™ technology which inherently overcomes manufacturing and environmental variances—no tuning.
- Up to 14 input X/Y self capacitance solution (minimum of 3 electrodes in both X/Y directions).
- Supports single and multiple layer X/Y transparent touch screens, non-transparent touch matrices, and potential absolute X/Y coordinates.
- Supports I²C communication with a bus speed of 400kbps. Interrupt notification of detected touch.
- Simple configuration structure and control attributes to the device.
- Electrodes can be designed with etched copper, printed silver, ITO (Indium Tin Oxide), AgNW (silver nanowire), and more.
- Operating Modes:
 - Monitor Mode (60hz scan rate): all electrodes are connected together and processed to maintain low power consumption to determine a touch event.
 - Active Mode (100hz scan rate): after Monitor Mode detects a touch, Active Mode will be initiated for processing X/Y coordinate data to be reported by I²C.



24 Pin QFN Package

Ordering Information

Part Number Format: VN0001XYZ

X (Packaging): **Q** = 24 Pin QFN

Y (Temperature Range): **I** = -40C — +85C

Z (Grade): **C** = Consumer

Platform part number for this simpletouch™ IC is Infineon CY8C4014LQI-422

For more information concerning the hardware specifications, please refer to the Infineon datasheet

Electrical Characteristics

Absolute Maximum Ratings*

Designation	Item	Condition	Rated Value	Unit
T _{amb}	Ambient Temperature	Under Bias	-40 — +85	°C
V _{dd}	Supply Voltage	V _{dd} with respect to V _{ss}	-0.5 — +6.0	V
I _{INT}	IRQ Line Current	Sourcing	25	mA
ESD_HBM	Electrostatic Discharge	Human Body Model	8000	V

* Exceeding the absolute maximum ratings may result in permanent damage to the device

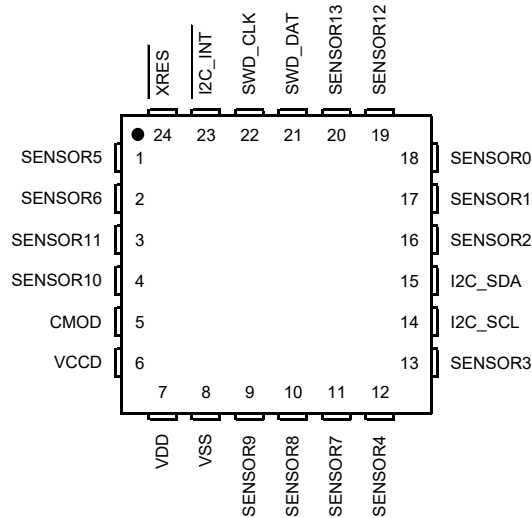
Operating Conditions

Designation	Item	Condition	Rated Value			Unit
			Min	Nominal	Max	
Supply Voltage = 3.3Vdc						
V _{dd}	Supply Voltage	+/-5%	3.14	3.30	3.46	V
I _{dd}	Supply Current (Monitor Mode ⁽¹⁾)	3.30v			200	μA
I _{dd}	Supply Current (Active Mode)	3.30v	2			mA
V _{riseipor}	Rising Trip Voltage		0.80		1.50	V
V _{fellipor}	Falling Trip Voltage		0.70		1.40	V
Common						
T _{amb}	Ambient Temperature	Industrial Temp Range	-40		+85	°C
T _{rstwidth}	Reset Low Pulse Width Timing		5			μs
T _{resetwake}	Wake-up Time From Reset Release				3	ms
T _{wakeup}	Time Before IC Is Ready	From POR	30			ms
T _{activescanrate}	Active Mode Scan Rate			100		hz
T _{monitorscanrate}	Monitor Mode Scan Rate			60		hz
T _{reportrate}	Data X/Y Report Rate			100		hz
T _{I2C_CLOCK}	I ² C Bus Clock			400		kbps

Notes:

- 1) At 60Hz scan rate.

Pinout Diagram



Pin	Name	Function	Description / Connection
1	SENSOR5	Touch Sensor Input	Connect to Sensor 5 Electrode
2	SENSOR6	Touch Sensor Input	Connect to Sensor 6 Electrode
3	SENSOR11	Touch Sensor Input	Connect to Sensor 11 Electrode
4	SENSOR10	Touch Sensor Input	Connect to Sensor 10 Electrode
5	CMOD	Sensor Capacitor	2200pF Ceramic Capacitor
6	VCCD	Power	Bypass with 1.0uF Ceramic Capacitor
7	VDD	Power	Supply Voltage Connection
8	VSS	Power	Ground Connection
9	SENSOR9	Touch Sensor Input	Connect to Sensor 9 Electrode
10	SENSOR8	Touch Sensor Input	Connect to Sensor 8 Electrode
11	SENSOR7	Touch Sensor Input	Connect to Sensor 7 Electrode
12	SENSOR4	Touch Sensor Input	Connect to Sensor 4 Electrode
13	SENSOR3	Touch Sensor Input	Connect to Sensor 3 Electrode
14	I2C_SCL	Interface	I ² C Clock Bus
15	I2C_SDA	Interface	I ² C Data Bus
16	SENSOR2	Touch Sensor Input	Connect to Sensor 2 Electrode
17	SENSOR1	Touch Sensor Input	Connect to Sensor 1 Electrode
18	SENSOR0	Touch Sensor Input	Connect to Sensor 0 Electrode
19	SENSOR12	Touch Sensor Input	Connect to Sensor 12 Electrode
20	SENSOR13	Touch Sensor Input	Connect to Sensor 13 Electrode
21	SWD_DAT	Programming	Data Bus
22	SWD_CLK	Programming	Clock Bus
23	I2C_INT	Digital Output (Active Low)	Touch Status Change Signal Line
24	XRES	Reset Input (Active Low)	Allows for Manual Reset of IC

Application Information

Block Diagram

Figure 1 shows a block diagram highlighting the main connections for the VN0001QIC01 IC in the default 7x7 matrix. Figure 2 highlights the connections for a 4x8 matrix. The X/Y electrodes are connected to the IC sequentially from SENSOR0—SENSOR13 with no unused inputs in between the electrodes. Columns (X) must be connected starting with Sensor0 and Rows (Y) should follow the last Column with Columns and Rows grouped together and not co-mingled. When used with X/Y electrodes, supported Number of Column values are 3 - 10 (default = 7) and supported Number of Row values are 3 - 10 (default = 7). Communication to the IC is accomplished through a standard master slave I²C interface with the addition of standard external pullup resistors to the bus. Use of the I2C_INT line allows for interrupt enabled communications upon touch state changes. The I2C_INT line is active low and requires an external pullup resistor to VDD.

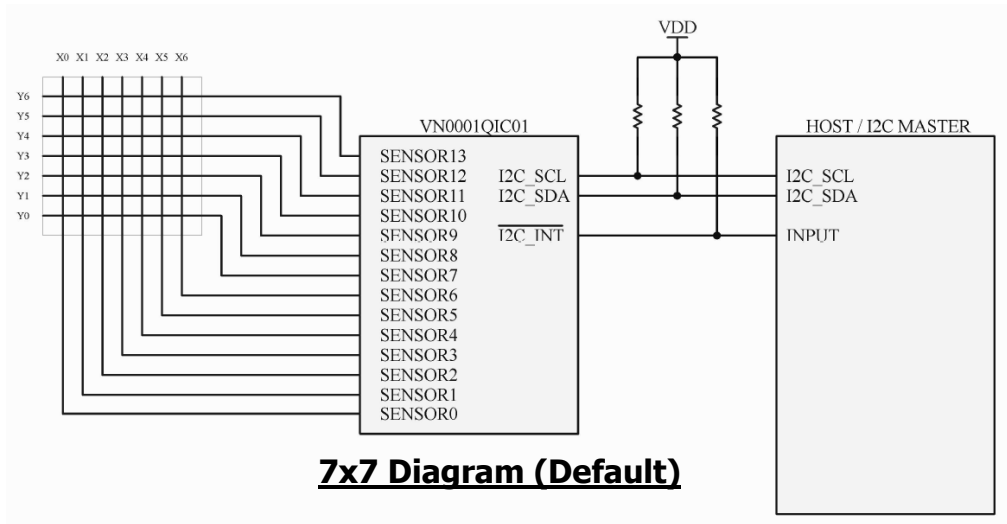


Figure 1

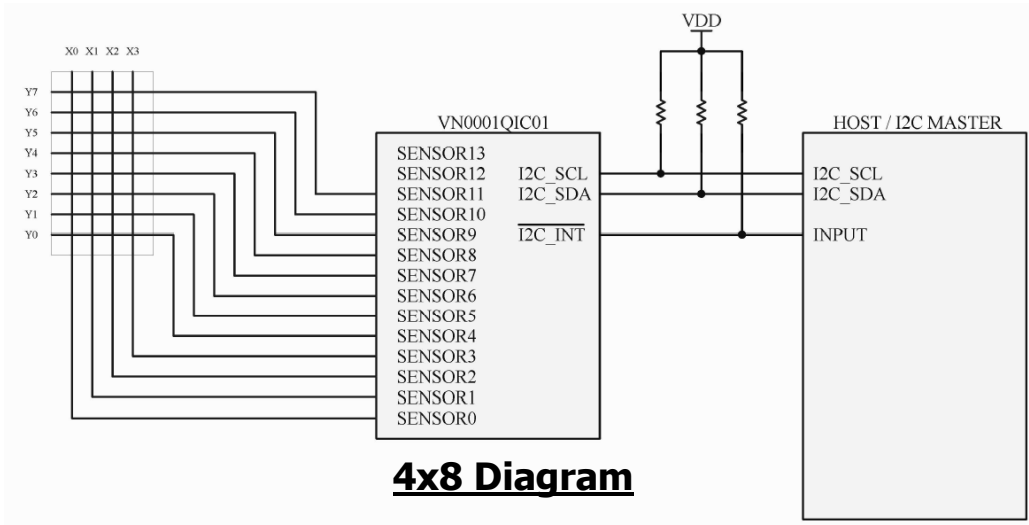


Figure 2

Application Information

Reference Design

Figure 3 shows a reference design for the VN0001QIC01 IC. All ceramic chip capacitors should be of good quality with a temperature coefficient of X7R (class 2) or better. The external I²C pullup resistors are omitted from this reference design, but the customer is responsible for including into their overall system design. Figure 4 shows the recommended diamond pattern range and spacing for X/Y electrodes.

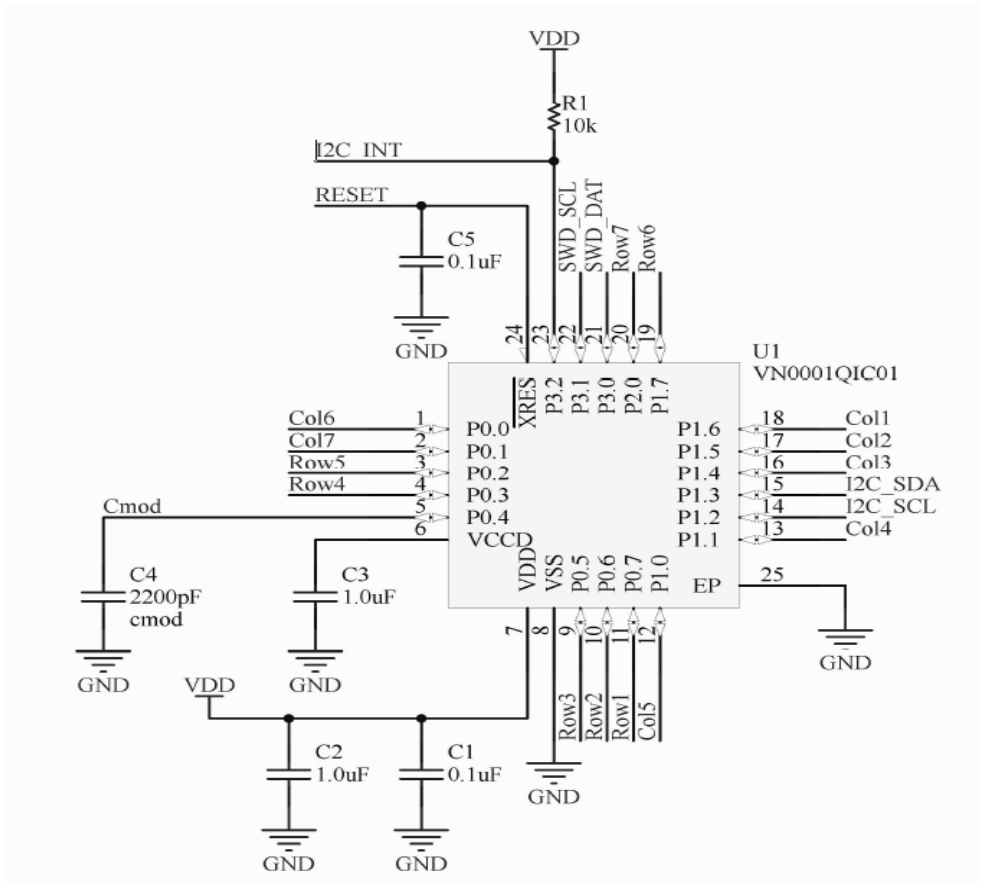


Figure 3

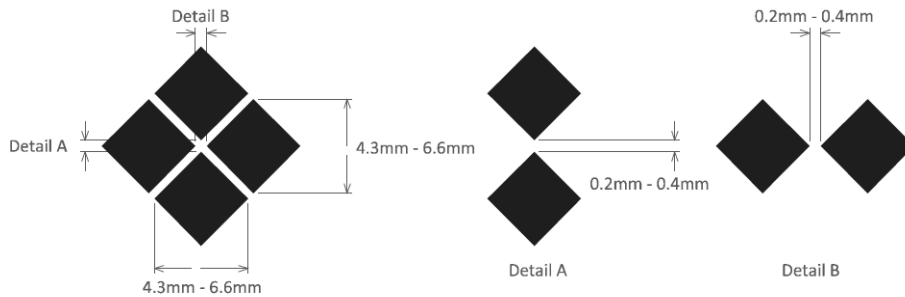


Figure 4

simpletouch™

I²C Interface

The Venntis® simpletouch™ IC is communicated with exclusively through I²C commands. Unless otherwise stated, the default I²C address for the simpletouch™ IC is 0x38 (7-bit addressing) with a data rate = 400kbps. Operation is in Slave mode only. An active low signal is generated on the I2C_INT pin when a change in touch state is detected with X/Y data ready for the Master IC to request. The user can choose to use the I2C_INT pin for automatic notification of a change in touch status or ignore the I2C_INT and manually ping the IC for the touch status at any time. The action of the I2C_INT pin is determined by the mode selected via the Master Write Interrupt Mode I²C command. The Master IC can update the simpletouch™ control register by issuing a Master Write simpletouch™ Configuration command with associated parameters at any time after POR.

simpletouch™ Configuration Defaults

Screen Type:

0x00 = e_Self (default)

0x01 = e_Mutual (not supported at this time)

Number of Columns:

Supported values = 3 - 10 when used with X/Y electrodes (default = 7)

Number of Rows:

Supported values = 3 - 10 when used with X/Y electrodes (default = 7)

X Pixel Range:

Supported Number of Pixels over the Number of Columns = 512 maximum (default = 390)

Y Pixel Range:

Supported Number of Pixels over the Number of Rows = 512 maximum (default = 390)

simpletouch™ Control Register:

Value = Do Not Care. The value of the simpletouch™ Control Register is subject to change and is controlled by the simpletouch™ IC.

EEPROM Initialize Status:

0x00 = Not Initialized (default)

0xAA = Initialized

Command Set

The VN0001QIC01 IC is configured and operated using the commands shown in the table below.

Command	Name
0x02	Master Request Touch Status
0x03	Master Request X/Y Data
0xA4	Master Write Interrupt Mode
0xA6	Master Request Firmware Version
0xA8	Master Request Panel ID Number
0xD0	Reserved
0xD1	Master Write simpletouch™ Configuration Bytes
0xD2	Master Request simpletouch™ Configuration Bytes

Example I²C Write/Read Sequence

Touch		I ² C CMD/Data	Description
0	Master Request	0x02	Request Touch Status
0	Slave Response	0x00	Respond With No Touch
.	.	.	.
1	Master Request	0x02	Request Touch Status
1	Slave Response	0x01	Respond With Touch
1	Master Request	0x03	Request Event Flag & X/Y Data
1	Slave Response	0x80, 0xnn, 0xnn, 0xnn	Respond With Event Flag & X/Y Data
1	Master Request ⁽¹⁾	0x03	Request Event Flag
1	Slave Response	0x80	Respond With Event Flag Status
.	.	.	.
0	Master Request	0x02	Request Touch Status
0	Slave Response	0x00	Respond With No Touch

Notes:

- 1) 2nd Request Event Flag required to maintain backward compatibility

Master Request Touch Status

Command Structure

Byte 1		
S	0x38 (Address)	A/N
Byte 2		
	0x02 (Command)	A/N
Byte 3		
RS	0x39	A/N
Byte 4		
	Touch Status Value	A/N
		P

Command Description

This command is used to **Read** the number of currently active touch points.

Touch Status Value:

0x00 = No Touch Detected
 0x01 = Single Touch Detected

Note:

- Currently only 1 touch point is supported, therefore a 0x01 will always be returned for the Touch Status Value when a touch is detected.

Master Request Touch Status Example:

	Master Out	Slave Out
Byte 1	0x38	Address
Byte 2	0x02	Command
Byte 3	0x39	Re-Start Command
Byte 4	0x01	Touch Status Value

Master Request X/Y Data

Command Structure

Byte 1		
S	0x38 (Address)	A/N
Byte 2		
	0x03 (Command)	A/N
Byte 3		
RS	0x39	A/N
Byte 4		
	Event Flag (bit7), X Position MSB (bits 6-0)	A/N
Byte 5		
	X Position LSB	A/N
Byte 6		
	Y Position MSB	A/N
Byte 7		
	Y Position LSB	A/N
		P

Command Description

This command is used to **Read** the X/Y location of the currently active touch point. The Event Flag (bit 7 of X Position MSB) will always be set.

Note:

- To preserve backward compatibility, after a 0x03 command is issued and the 4 byte response is received by the Master; it is required for the Master to issue a 2nd 0x03 command in which the slave will respond only with 1 byte with the Event Flag set (0x80). Not issuing a 2nd 0x03 command and receiving 0x80 back will result in unexpected behavior issuing further Master Request X/Y Data commands. The Event Flag is a flag to maintain backward compatibility.

Master Request X/Y Data Example:			Master Out	Slave Out
Byte 1	0x38	Address		
Byte 2	0x03	1st Request Command		
Byte 3	0x39	Re-Start Command		
Byte 4	0x80	Event Flag & X Position MSB		
Byte 5	0xA0	X Position LSB		
Byte 6	0x01	Y Position MSB		
Byte 7	0x00	Y Position LSB		
Byte 8	0x38	Address		
Byte 9	0x03	2nd Request Command		
Byte 10	0x39	Re-Start Command		
Byte 11	0x80	Event Flag Only		

Master Write Interrupt Mode

Command Structure

Byte 1	S	0x38 (Address)	A/N
Byte 2		0xA4 (Command)	A/N
Byte 3		Interrupt Mode Value	A/N
			P

Command Description

This command is used to **Write** the mode of operation for the interrupt pin. If the default mode is not used, this parameter must be written on start-up.

Interrupt Mode Value:

0x00 = Interrupt Polling Mode (default)

0x01 = Interrupt Trigger Mode

Note:

- In Interrupt Polling Mode, the active low I2C_INT line remains low for as long as there is a valid touch detected.
- In Interrupt Trigger Mode, the active low I2C_INT line remains low for 50 microseconds once a valid touch is detected and repeats at 100hz rate as long as the valid touch is detected.

Master Write Interrupt Mode Example:

	Master Out	Slave Out
Byte 1	0x38	Address
Byte 2	0xA4	Command
Byte 3	0x01	Interrupt Mode Value

Master Request Firmware Version

Command Structure

Byte 1		
S	0x38 (Address)	A/N
Byte 2		
	0xA6 (Command)	A/N
Byte 3		
RS	0x39	A/N
Byte 4		
	Firmware Version Value	A/N
		P

Command Description

This command is used to **Read** the firmware version of the simpletouch™ IC.

Master Request Firmware Version Example:			Master Out	Slave Out
Byte 1	0x38	Address		
Byte 2	0xA6	Command		
Byte 3	0x39	Re-Start Command		
Byte 4	0x01	Firmware Version Value		

Master Request Panel ID

Command Structure

Byte 1		
S	0x38 (Address)	A/N
Byte 2		
	0xA8 (Command)	A/N
Byte 3		
RS	0x39	A/N
Byte 4		
	Panel ID Value	A/N
		P

Command Description

This command is used to **Read** the panel identification of the simpletouch™ IC.

Master Request Panel ID Example:			Master Out	Slave Out
Byte 1	0x38	Address		
Byte 2	0xA8	Command		
Byte 3	0x39	Re-Start Command		
Byte 4	0x30	Panel ID Value		

Master Write Reserved

Command Structure

Byte 1		
S	0x38 (Address)	A/N
Byte 2		
	0xD0 (Command)	A/N
Byte 3		
	Value To Be Determined	A/N
		P

Command Description

This command is used to **Write** TBD.

Note:

- This command is reserved for future simpletouch™ IC use.

Master Write Reserved Example:			Master Out	Slave Out
Byte 1	0x38	Address		
Byte 2	0xD0	Command		
Byte 3	0x00	Value TBD		

Master Write simpletouch™ Config

Command Structure

Byte 1		
S	0x38 (Address)	A/N
Byte 2		
	0xD1 (Command)	A/N
Byte 3		
	Screen Type	A/N
Byte 4		
	Number of Columns	A/N
Byte 5		
	Number of Rows	A/N
Byte 6		
	X Pixel Range MSB	A/N
Byte 7		
	X Pixel Range LSB	A/N
Byte 8		
	Y Pixel Range MSB	A/N
Byte 9		
	Y Pixel Range LSB	A/N
Byte 10		
	simpletouch™ Control Register	A/N
Byte 11		
	EEPROM Initialize Status	A/N
		P

Command Description

This command is used to **Write** a new simpletouch™ configuration to the IC which automatically re-initializes the simpletouch™ IC to the new configuration.

Screen Type:

0x00 = e_Self (default)
 0x01 = e_Mutual (not supported at this time)

Number of Columns:

Supported values = 3 - 10 when used with X/Y electrodes (default = 7)

Number of Rows:

Supported values = 3 - 10 when used with X/Y electrodes (default = 7)

X Pixel Range:

Supported Number of Pixels over the Number of Columns = 512 maximum (default = 390)

Y Pixel Range:

Supported Number of Pixels over the Number of Rows = 512 maximum (default = 390)

simpletouch™ Control Register:

Value = Do Not Care. The value of the simpletouch™ Control Register is subject to change and is controlled by the simpletouch™ IC.

EEPROM Initialize Status:

Value = Do Not Care (this value is ignored by the simpletouch™ IC)

Master Write simpletouch™ Config Example:			Master Out	Slave Out
Byte 1	0x38	Address		
Byte 2	0xD1	Command		
Byte 3	0x00	Screen Type		
Byte 4	0x07	Number of Columns		
Byte 5	0x07	Number of Rows		
Byte 6	0x01	X Pixel Range MSB		
Byte 7	0x86	X Pixel Range LSB		
Byte 8	0x01	Y Pixel Range MSB		
Byte 9	0x86	Y Pixel Range LSB		
Byte 10	0x00	simpletouch™ Control Reg		
Byte 11	0x00	EEPROM Initialize Status		

Master Request simpletouch™ Config

Command Structure

Byte 1		
S	0x38 (Address)	A/N
Byte 2		
	0xD2 (Command)	A/N
Byte 3		
RS	0x39	A/N
Byte 4		
	Screen Type	A/N
Byte 5		
	Number of Columns	A/N
Byte 6		
	Number of Rows	A/N
Byte 7		
	X Pixel Range MSB	A/N
Byte 8		
	X Pixel Range LSB	A/N
Byte 9		
	Y Pixel Range MSB	A/N
Byte 10		
	Y Pixel Range LSB	A/N
Byte 11		
	simpletouch™ Control Register	A/N
Byte 12		
	EEPROM Initialize Status	A/N
		P

Command Description

This command is used to **Read** the simpletouch™ IC configuration settings.

Notes:

The value of the simpletouch™ Control Register is subject to change and is controlled by the simpletouch™ IC. Reading this value may not reflect the same value which was written to the IC.

EEPROM Initialize Status:

0x00 = Not Initialized (default)

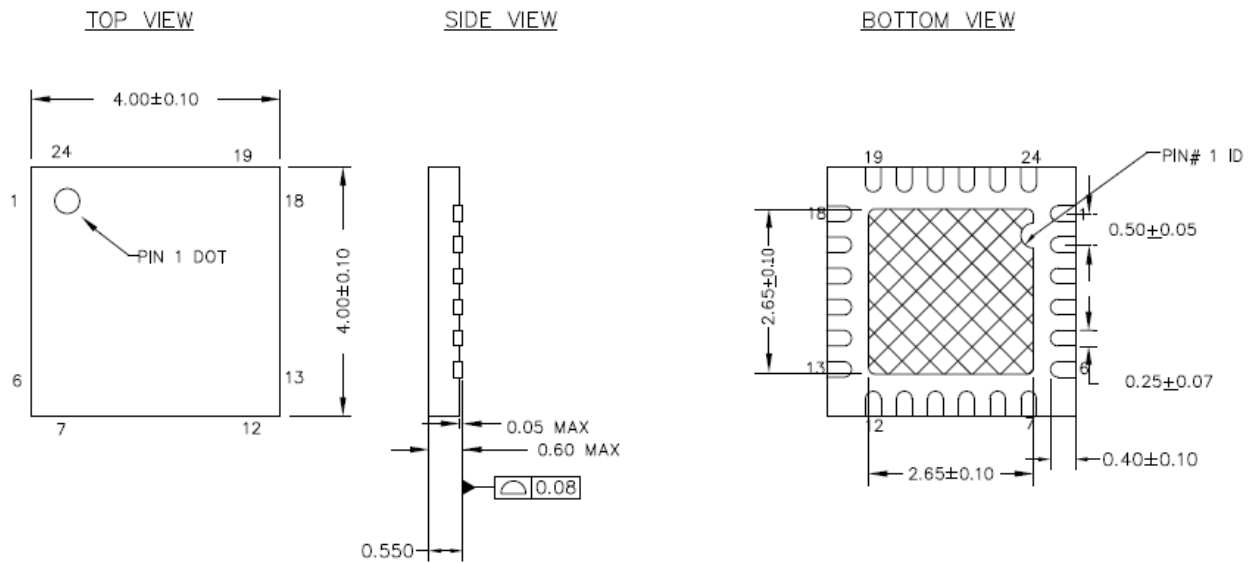
0xAA = Initialized

Master Request simpletouch™ Config Example:


	Master Out	Slave Out
Byte 1	0x38	Address
Byte 2	0xD2	Command
Byte 3	0x39	Re-Start Command
Byte 4	0x00	Screen Type
Byte 5	0x07	Number of Columns
Byte 6	0x07	Number of Rows
Byte 7	0x01	X Position MSB
Byte 8	0x86	X Position LSB
Byte 9	0x01	Y Position MSB
Byte 10	0x85	Y Position LSB
Byte 11	0x00	simpletouch™ Control Reg
Byte 12	0x00	EEPROM Init Status

simpletouch™ Package Outline Drawing

24-pin QFN EPAD (Sawn) – 4x4x0.55 mm Body [QFN] with Exposed Pad



NOTES :

1.  HATCH IS SOLDERABLE EXPOSED METAL.
2. REFERENCE JEDEC # MO-248
3. PACKAGE WEIGHT : 29 ± 3 mg
4. ALL DIMENSIONS ARE IN MILLIMETERS

001-13937 *G

The center pad on the QFN package should be connected to ground (VSS) for best mechanical, thermal, and electrical performance.

If not connected to ground, it should be electrically floating and not connected to any other signal

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