



## STEVAL-ICB001V1, touch sensor demonstration board based on the STMPE1208S

### Introduction

This document explains the functioning of the capacitive touch sensor demonstration board consists of the capacitive touch sensor device, STMPE1208S, and 8-bit microcontroller, ST72F63B, as I<sup>2</sup>C master along with a PC GUI (graphical user interface).

The objective of this demonstration board is to display to the user the features and capabilities of the capacitive touch sensor device (STMPE1208S) using a Windows-based host software application and an 8-bit USB low-speed microcontroller (ST72F63BK6) acting as a control device.

The PC host software and the microcontroller source code provide a user friendly environment to use demonstration board in following modes:

- Standalone mode
- PC GUI mode.

The power to board is provided from USB mini B-type connector or using AAA size Ni batteries.

In this demonstration board, the ST72F63BK6 microcontroller acts as the I<sup>2</sup>C master and controls STMPE1208S device functioning as I<sup>2</sup>C slave. The STMPE1208S devices are used to interface touch keys, slider and rotator. The touch keys are handled by STMPE1208S device and response is given to ST72F63BK6 through I<sup>2</sup>C communication. Slider and rotator are implemented in microcontroller firmware and it is based on the change in capacitance value upon touch and this information is provided by STMPE1208S using I<sup>2</sup>C. In standalone mode, all the events are visible in a monochrome LCD (64 X 128).

For interfacing with the PC GUI, the application layer is built above the USB core library that makes all the hardware control of the USB interface transparent for the developers.

Besides displaying all the touch events, PC GUI also provides possibility of accessing the S-Touch™ device internal registers from the PC. It is possible to use this option to fine tune the any daughter board based on S-Touch™ device.

Also the board has in circuit connector (ICC) to re-program the ST72F63BK6 8-bit microcontroller Flash memory.

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# 1 Getting started

## 1.1 System requirements

In order to use the capacitive touch sensor demonstration board with the Microsoft® Windows™ operating system, a recent version of Windows, such as Windows 2000™ or Windows XP™ must be installed on the PC. The version of the Windows operating systems installed on your PC may be determined by clicking on the "System" icon in the control panel (please, refer to manual of your PC and/or Microsoft Windows).

## 1.2 Package contents

The capacitive touch sensor demonstration board includes the following items:

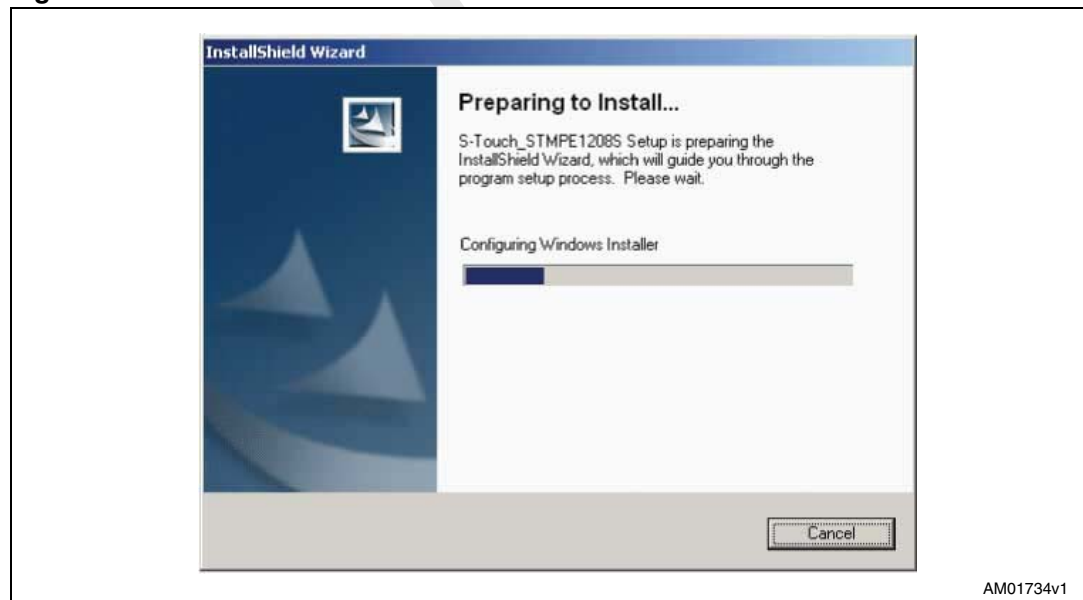
- Hardware content:
  - One demonstration board, STEVAL-ICB001V1
- Software content:
  - PC executable software to be used along with demonstration board
- Documentation:
  - User manual

## 1.3 Software installation

To install the PC GUI software, follow the step as mentioned below:

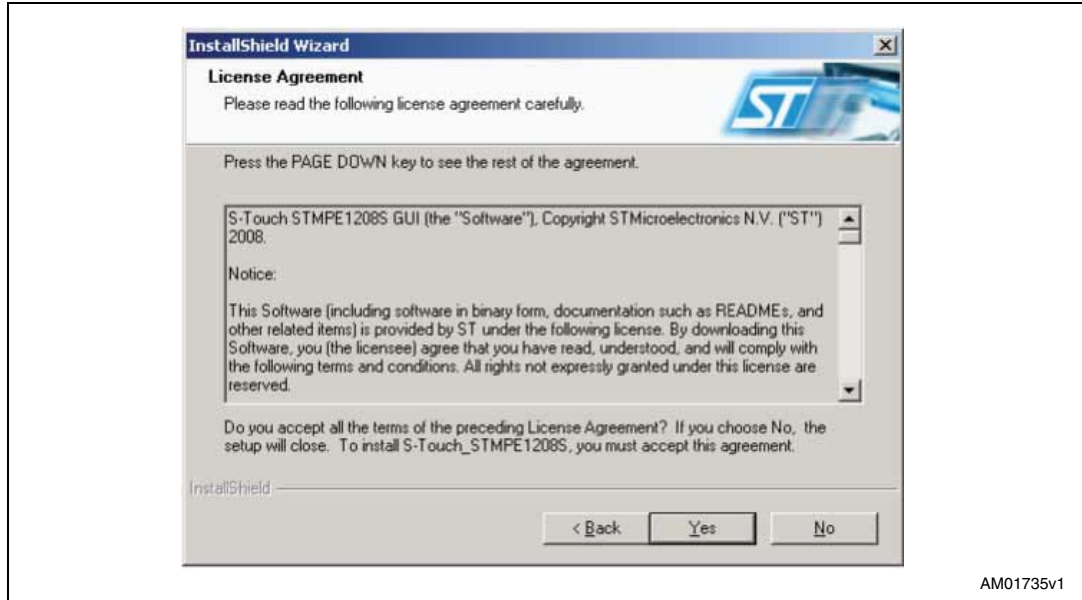
- Step1: As soon as the user clicks the setup.exe Icon. The following Window appears.

Figure 1. Installation Window



- Step 2: Read the software license agreement and click the "Yes" button if you accept the license.

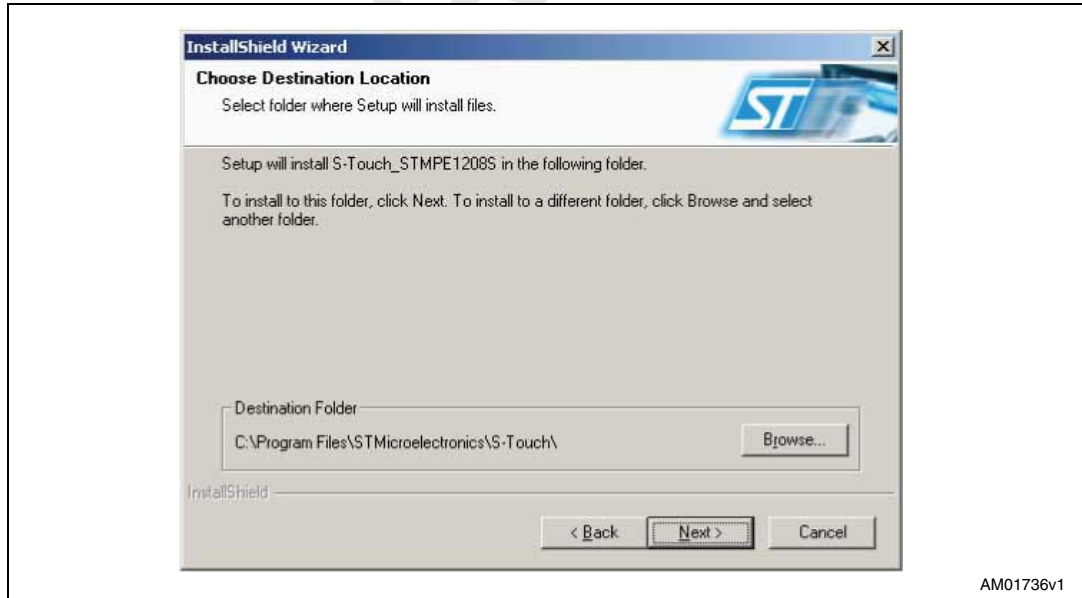
**Figure 2. License Window**



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- Step 3: Please select the folder in which, you want to install the software. By default it will install the software in the following path- C:\Program Files\STMicroelectronics\S-Touch\STMPE1208S.

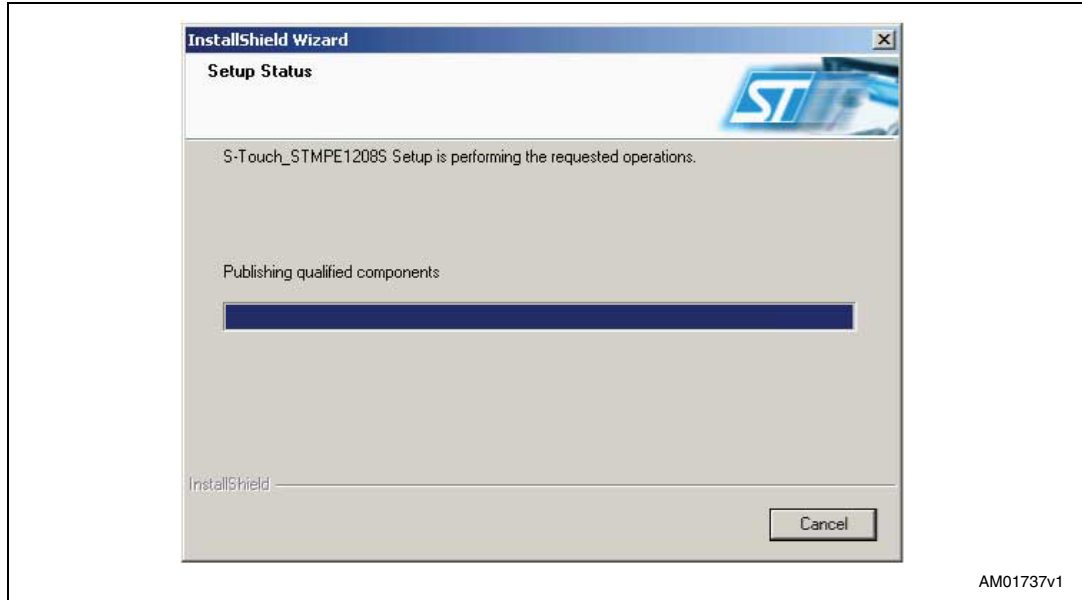
**Figure 3. Destination folder**



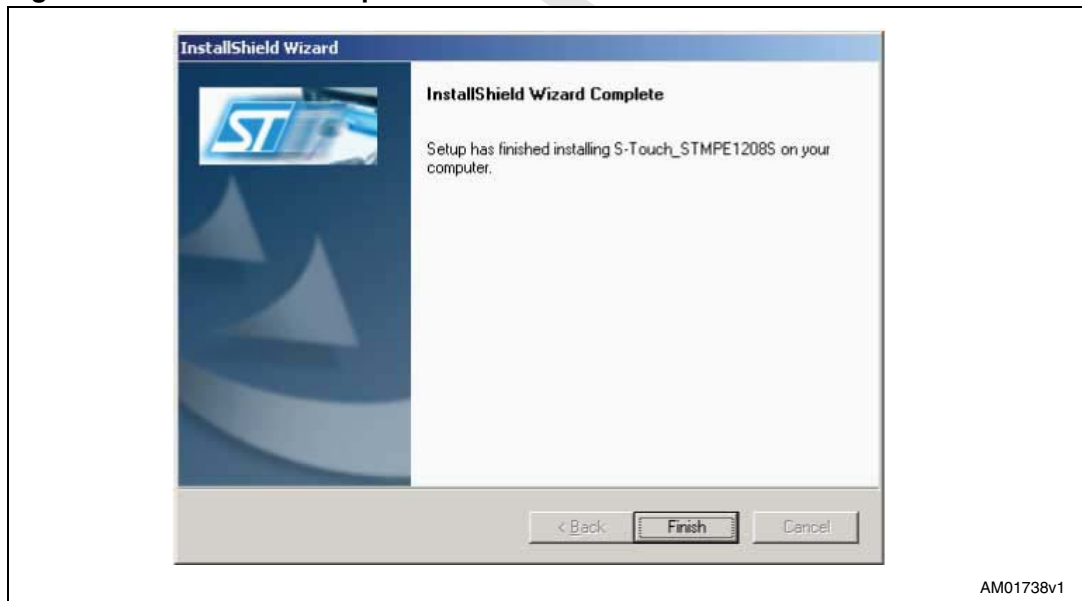
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- Step 4: After you select the folder and click the next button, it will start installing the software

**Figure 4. Installation ongoing**



**Figure 5. Installation complete**

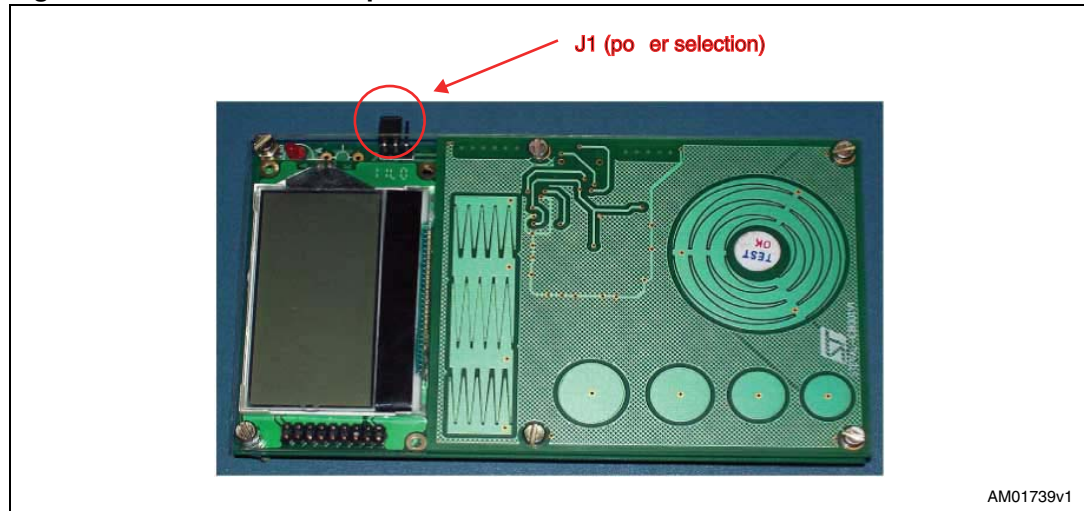


After you click the "Finish Button", you will find that the software is installed in the directory you selected or in the default directory. Also you will find the shortcut of this software also available in you START menu. This user manual is also available in the same directory.

## 1.4 Hardware installation

Figure 6 below shows the snapshot of the STMPE1208S demonstration board, STEVAL-ICB001V1.

Figure 6. STMPE1208S capacitive touch sensor demonstration board

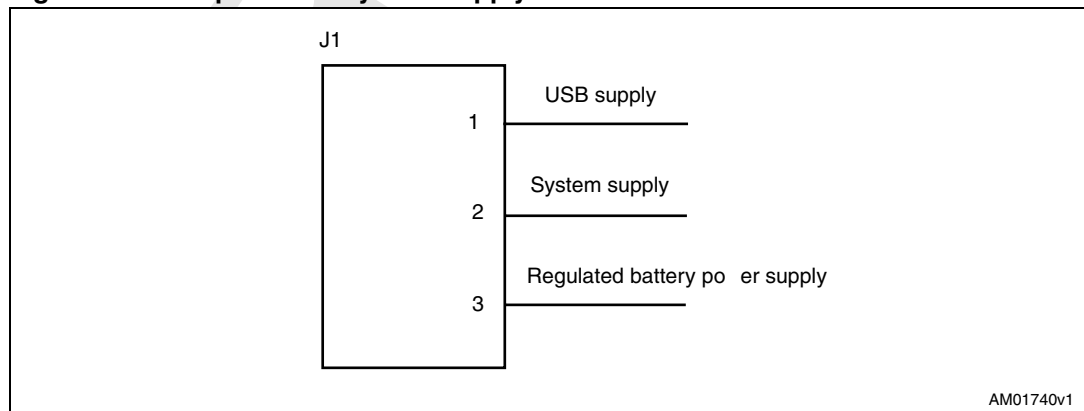


### 1.4.1 Power supply

The demonstration board can be power from USB mini B-type connector (Bus powered) or 3 AAA size batteries which can be connected to the battery holder connected on the back side. The selection of these supplies is done using jumper J1 as explained below.

- J1: J1 is the jumper between the 1.8 V supply voltage and the supply pins of STMPE1208S as shown in Figure 7 below. We can use it for measuring the current consumed by 1.8 V power supply or STMPE1208S device.

Figure 7. Jumper J1 for system supply selection



## 2 Running the STMPE1208S capacitive touch sensor demonstration board

This capacitive touch sensor demonstration board consists of two main parts:

- PC GUI
- Demonstration board.

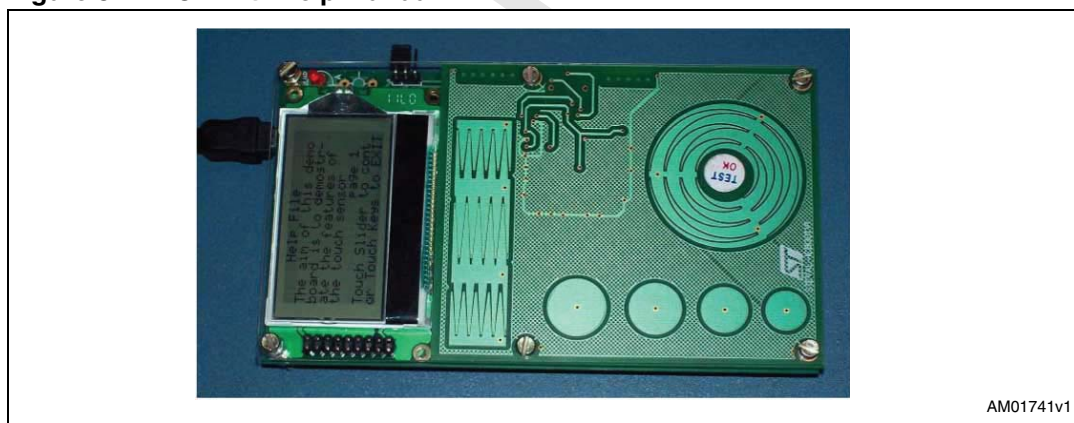
Again in standalone mode, the demonstration board can be used without PC GUI. Also power supply can be given from Mini USB B-Type connector or battery using J1. In case of PC GUI mode, the supply to the demonstration board should be given from mini USB B-type connector.

### 2.1 Running in standalone mode

With in a few seconds after you plug in the power supply, a welcome message should come on LCD and this means that the demonstration has started correctly.

After that you will see a series of messages coming on the LCD screen. At the end, you will see a help manual explaining the features available in the stand alone mode. This is shown in [Figure 8](#).

**Figure 8. LCD with help manual**



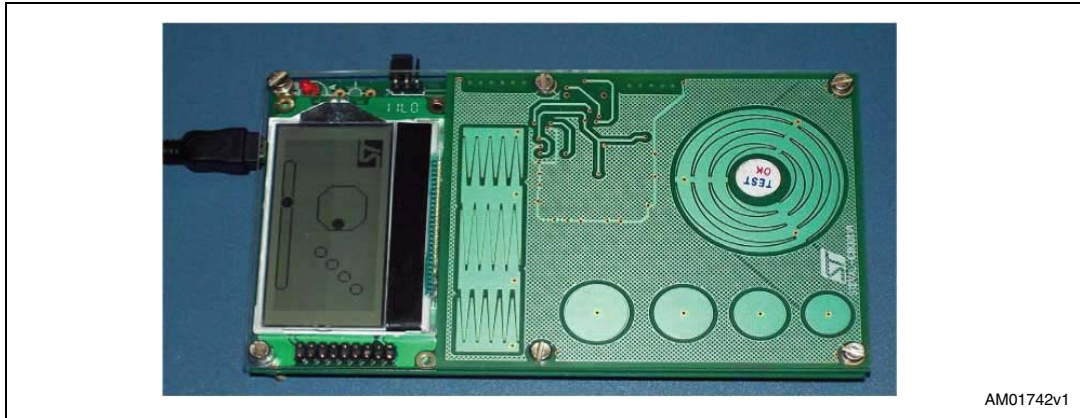
For the first time user, it is advisable to go through the help manual. You can navigate through the help menu by sliding your finger on slider. To exit from help mode, please touch any keys available on the demonstration board.

Again if you find that no message is coming on the LCD after giving the power supply. Remove the power supply and plugged in again and then observe. You should now see the message coming on the LCD. If this does not happen even after removing and plugged in the power supply several times, you need to contact technical support.

#### 2.1.1 Event detection

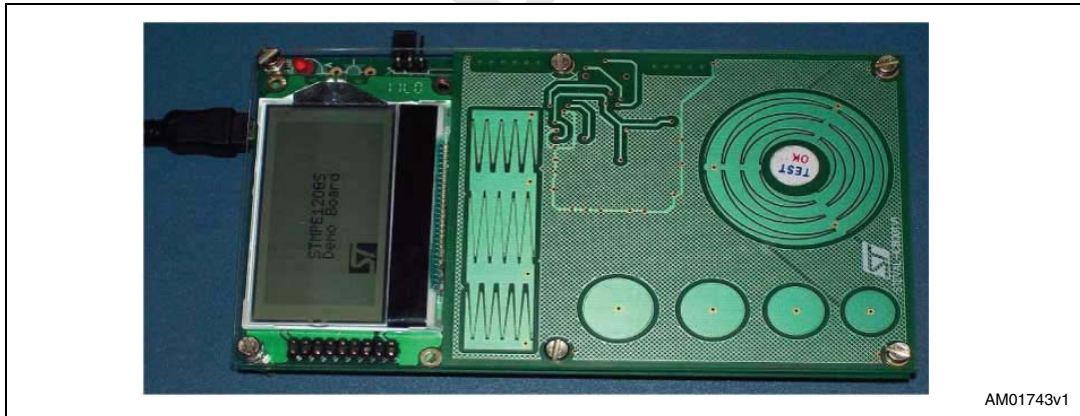
We can observe the touch events on the 64X128 monochrome LCD available on the demonstration board. As soon as you touch any keys, slider and rotator, there are some activities on the LCD corresponding to that as shown in [Figure 9](#).



**Figure 9. LCD showing touch events**

### 2.1.2 Screen saver mode in standalone mode

The demonstration has a screen saver mode. The demonstration enters in screen saver mode if there is no event for quite some time as shown in [Figure 10](#). The demonstration comes out of the screen saver mode once a touch event happens on the demonstration board.

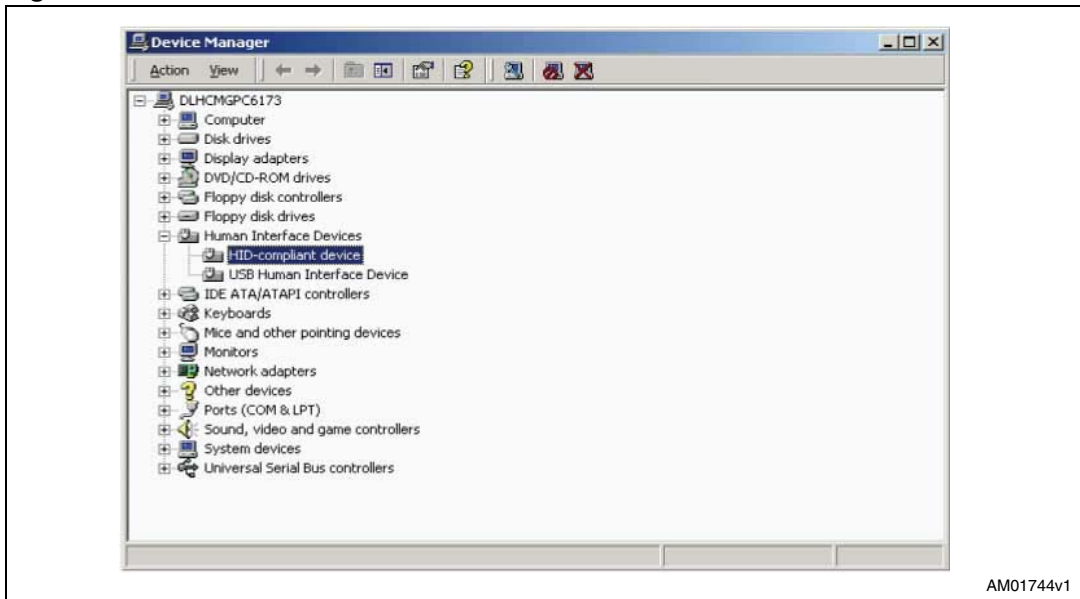
**Figure 10. Screen saver mode**

## 2.2 Running in PC GUI mode

In GUI mode, in addition to the functionalities mentioned in the above section, PC GUI is also available. For running the GUI, the demonstration board must first be connected to the PC with the USB mini B-type cable after doing proper setting of J1 as described in [Section 1.4.1](#).

As a result, you should find the demonstration board enumerated as a HID device as shown [Figure 11](#), and then board will be ready to use, if this message does not come contact the technical support.

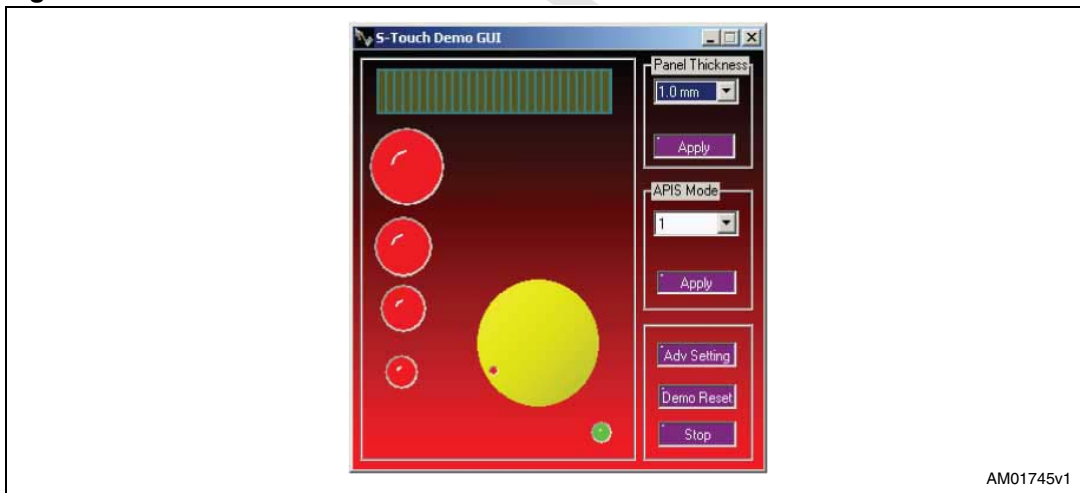
Figure 11. Enumeration result



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By starting the STMPE1208S PC GUI on the PC, you will see a graphical interface (Figure 12) for controlling the demonstration board. This PC software is used to issue various commands and to control data transfer between the PC and the ST7 peripheral.

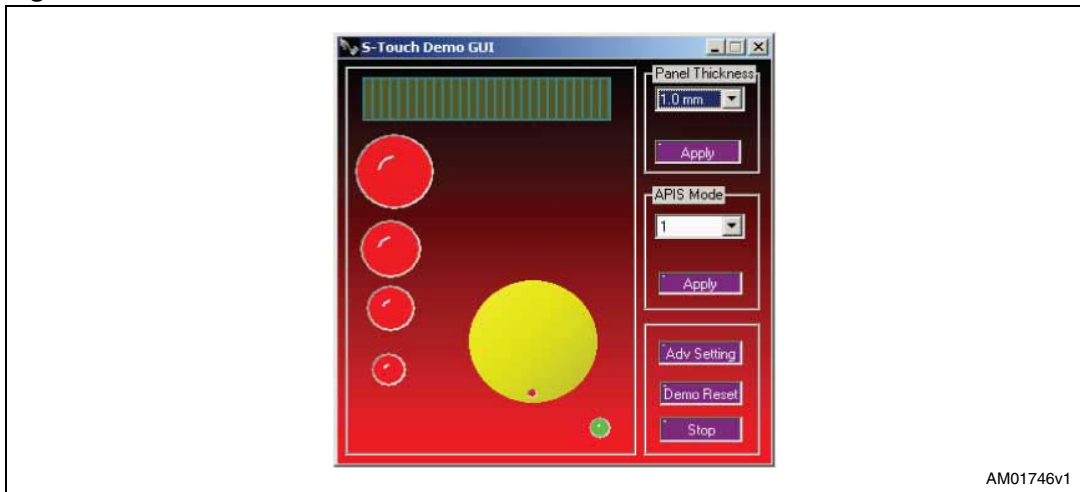
Figure 12. S-Touch™ PC GUI



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Again as you can see in the Figure 13, you can see whether the board is connected to the PC or not by observing the LED available on the GUI. If it is in "GREEN" color then boards is connected to the PC and if it is in "RED" color then it means that board is not connected to the PC.

**Figure 13. LED for demonstration connection status**



Once this is done, the PC GUI is properly connected to the demonstration board and ready to be used.

Now there are two modes operation in which GUI operates:

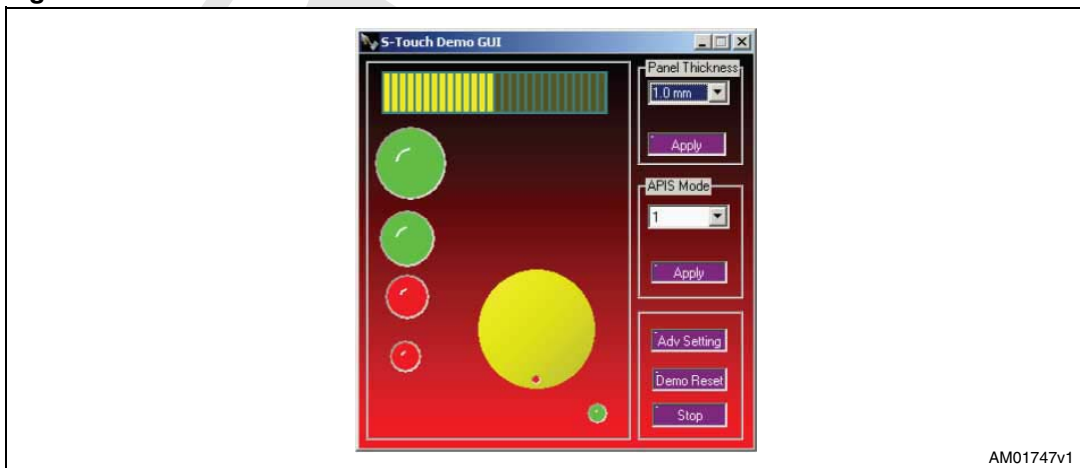
- Read/scan mode; by default GUI opens in this mode only
- Advance setting mode.

In addition to these two modes, again there is a RESET option and CAL options available in the GUI. RESET command is used to put the demonstration back in default settings and CAL is used to calibrate all the touch keys available on the demonstration board.

### 2.2.1 Read/scan mode

By default, user is in this mode only. In this mode similar to standalone mode, user can observe the touch events in GUI Window as shown in the [Figure 14](#).

**Figure 14. Read/scan mode**



Again there are certain features which are also supported in the main Window. These are as follows-

- Panel thickness menu: there are following options:
  - 1.0 mm
  - 1.5 mm
  - 2.0-mm

*Note: in the present version only 1.5 mm panel thickness is supported.*

- APIS mode menu: there are following options:
  - APIS mode 1: only one strongest key is detected
  - APIS mode 2: all the valid touch keys are detected
  - APIS mode 3: only two strongest keys are detected.
- demonstration reset button:

Once this button is clicked then the demonstration board gets resettled. Please wait till you get following message.

**Figure 15. Message**



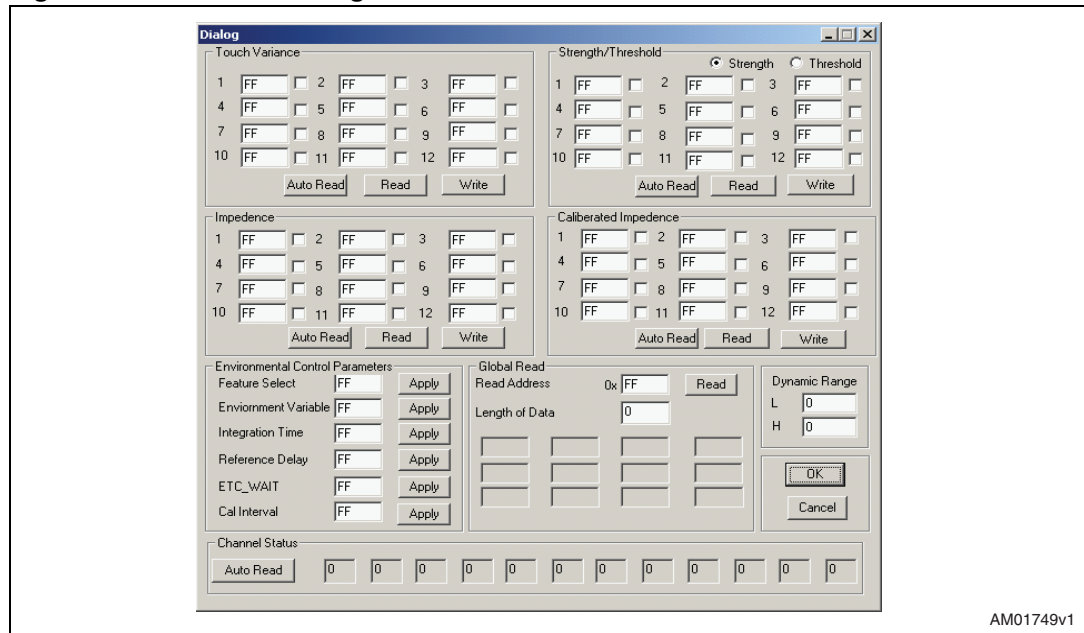
- scan board / STOP button:

This button is used to enable the capturing of the touch events on the demonstration boards in the scan Window. By pressing the "Scan Board" button, the scan Window gets enabled and the status of the button changes to "STOP". The scanning is stopped once we click either "STOP" button or if we want to do any other operations like changing the panel thickness, changing the APIS mode. Once scan Window is disabled, the status of the button again becomes "Scan Board".

### 2.2.2 Advance setting mode

We enter in to this mode by clicking the "Adv Setting" button, a Window appear as in [Figure 16](#).

Figure 16. Advance setting Window

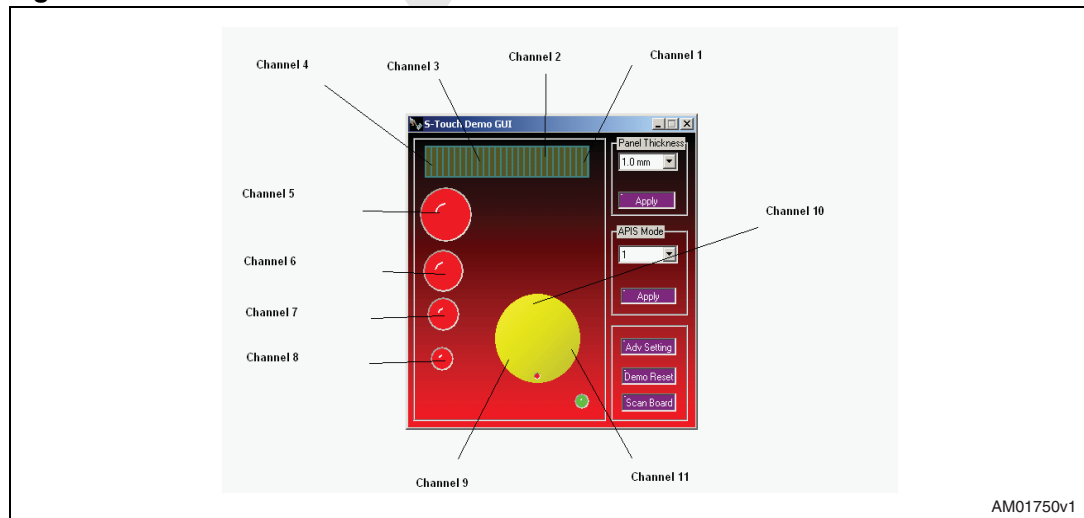


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In this advance setting Window there are several internal parameters from S-Touch™ device which you can observe and vary and hence it allows you a better control over the device operations.

Again to explain further, in the S-Touch™ demonstration board, there are 11 touch channels used out of 12 channels whose arrangements in the demonstration board is given in [Figure 17](#).

Figure 17. S-Touch™ GUI



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Here channel number 1-4 forms the slider and channel number channel 9-11 forms the rotator part hence you can get overlap impedance readings while reading the values in among channel number 1-4 and similarly among channel number 9-11.

Following few paragraphs will explain in more details, the operation you can perform:

- Touch variance section:

There are three buttons - 1) Read, 2) Auto Read and 3) Write; If you click "Read" button, it will read back the touch variance of the touch channels.

If you click the "Auto Read" button then it will keep reading continuously the touch variance hence you can see if there any changes made.

Now to write in to the touch variance of the individual touch channel, we need to write in to the individual check box and also select the corresponding check box. Now once we click the "Write" button, the values will be written in all the touch channels whose check boxes are clicked.

- strength/ threshold section:

This works similar to touch variance section but here there is additional check button to select between strength and strength threshold. Rest of the setting remains the same.

- Impedance section:

Works similar to the touch variance section.

- calibrated Impedance section:

Works similar to the touch variance section.

- environmental control section:

Here it is allowed to changed certain important parameters like feature select (or APIS mode selection), environmental variable (or Beta), integration time etc.

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**Warning:** here due to change in this variable the normal operations of the demonstration board may be affected. In that case you can always go back to the main Window and click "Demonstration Reset" button.

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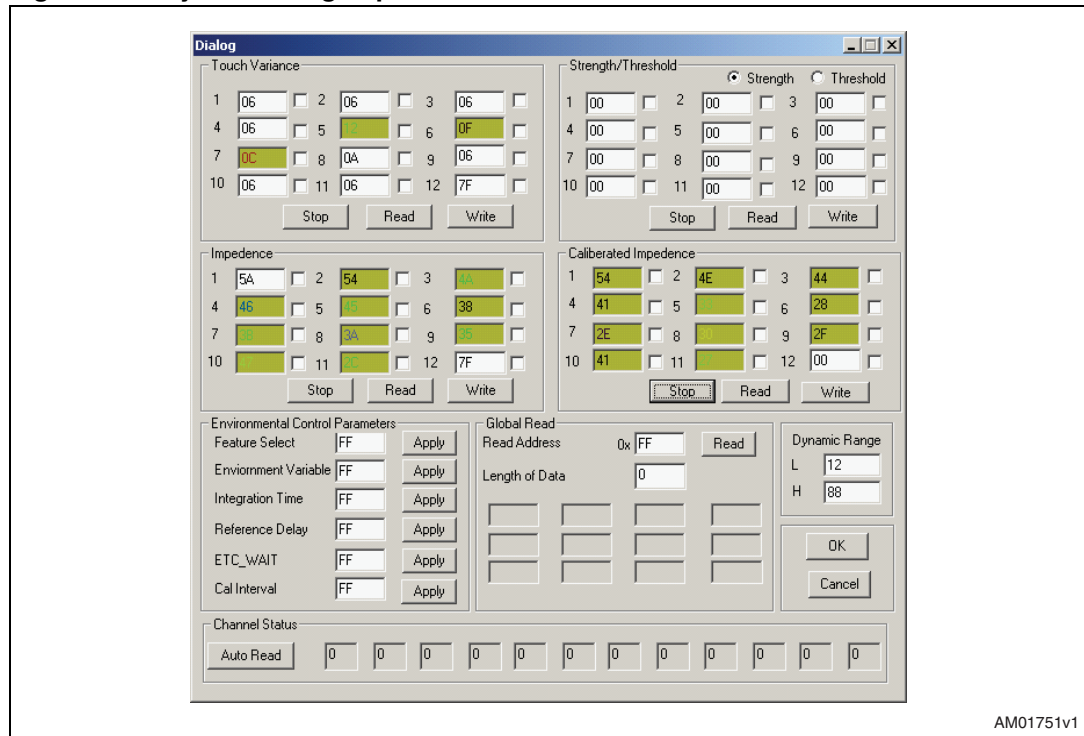
- Global read:

This option allows you to read 12 bytes in one go. Here you can write the register value and the length of the data (max 12). Once you click the "Read" Button, the corresponding data will come in to the text box available in this section.

- Dynamic range:

This option defines a range for values displayed using the "Auto Read" button, here the color coding is used and depending whether any value is in the range or outside the range described in this section, there color is chosen as shown in [Figure 18](#).

Figure 18. Dynamic range operation



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This option allows you to read 12 bytes in one go. Here you can write the register value and the length of the data (max 12). Once you click the "Read" Button, the corresponding data will come in to the text box available in this section.

Note:

*the values in dynamic range registers are in integers and in other sections in hex.*

- Channel status section:  
This option allows you to observe you the touch channels status whether they are in touch condition or not.

### 3 Using advance setting mode to fine tuning STMPE1208S based S-Touch™ daughter board

To fine tune any S-Touch™ device based daughter board, you need to first disassemble the demonstration board and connect the daughter board with the 10 pin SMD connector (J3) available in the main board. The pin count of this connector is as follows in [Table 1](#).

**Table 1. 10 pin connector pin definition**

Pin number	Pin definition
1	I <sup>2</sup> C clock line
2	I <sup>2</sup> C data line
3	Ground
4	VDD
5	TINT
6	GINT
7	Not used currently
8	RESET
9	Not used currently
10	Not used currently

So once the daughter board is connected to this connector (J3) with the pin diagram as shown in above table, it is ready to be fine tuned, here the I<sup>2</sup>C slave address is fixed at 0xB0, hence the in the S-Touch™ daughter board you need to fix the I<sup>2</sup>C address lines ID0 and ID1 as 0.

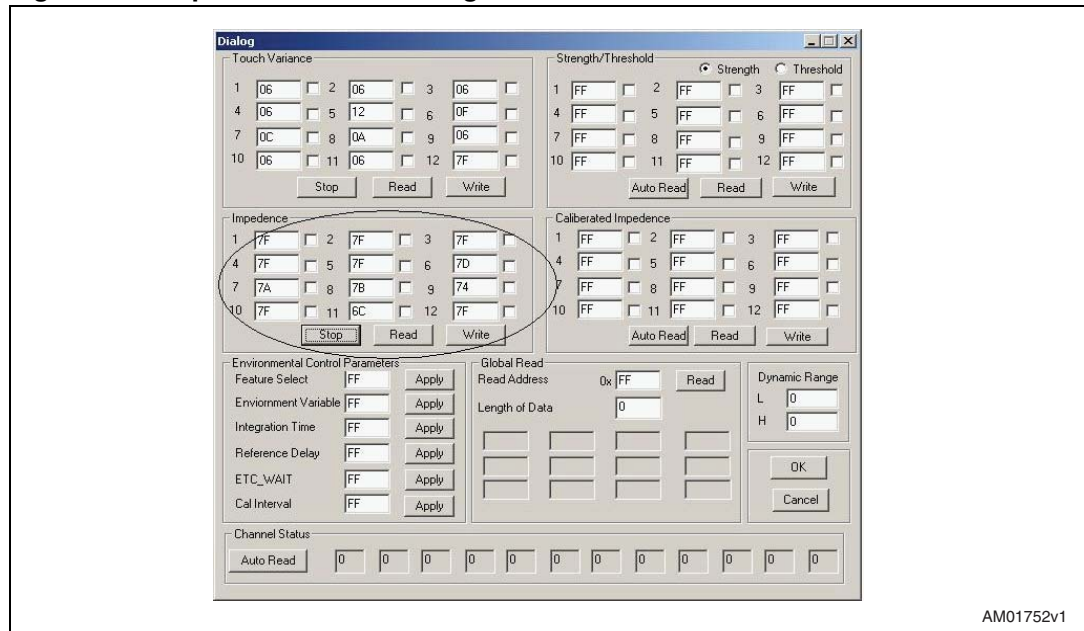
To fine the daughter board, once we have done the above settings. Then we need to start the GUI and go to advance setting Window.

To fine tune the daughter board we need to follow below steps.

- First read back the values of the Impedances values of each touch channels and see the dynamic range of the default values of the impedances of each touch channel. Impedance values can be read as mentioned in circled area in [Figure 19](#).



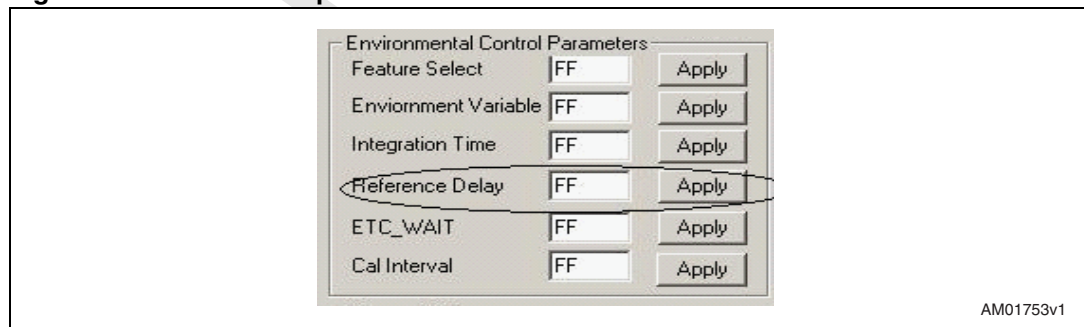
Figure 19. Impedance value reading



There are following interpretations that can be made of these impedance readings:

- If all the values are '0' (Maximum impedance), this means that default capacitance on the touch channel due to environmental conditions like track length etc. For this we can add a capacitor of on the REF pin of the S-Touch™ device and read back again the impedance values. We need to repeat this step by incrementing the values of the capacitance on REF lines in units of 1 pF up to dynamic range given in the data sheet starting from 1pF values.
- Again In the demonstration board the default values of the REF DELAY is 100 (the maximum values allowed). REF DELAY is the software way of adding the capacitance on the REF pin. Please see the STMPE1208s datasheet for more detail. REF DELAY parameter can be updated by filling the "Reference Delay" field in "Environmental Control Parameters" section and then click the corresponding "APPLY" field as shown in [Figure 20](#).

Figure 20. REF DELAY parameter

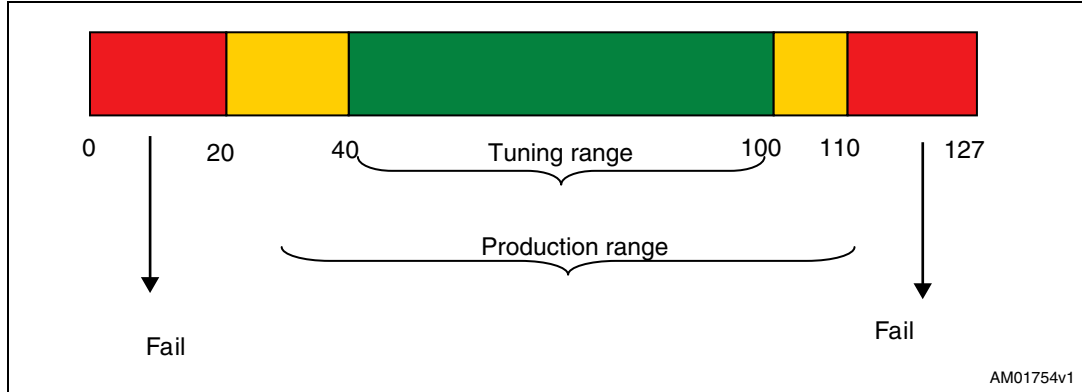


So if even after adding maximum capacitance value at the REF pin, if the default impedance values are still '0' then it means there is problem in board designing and we need to re-design the daughter board.

**Using advance setting mode to fine tuning STMPE1208S based S-Touch™ daughter board**

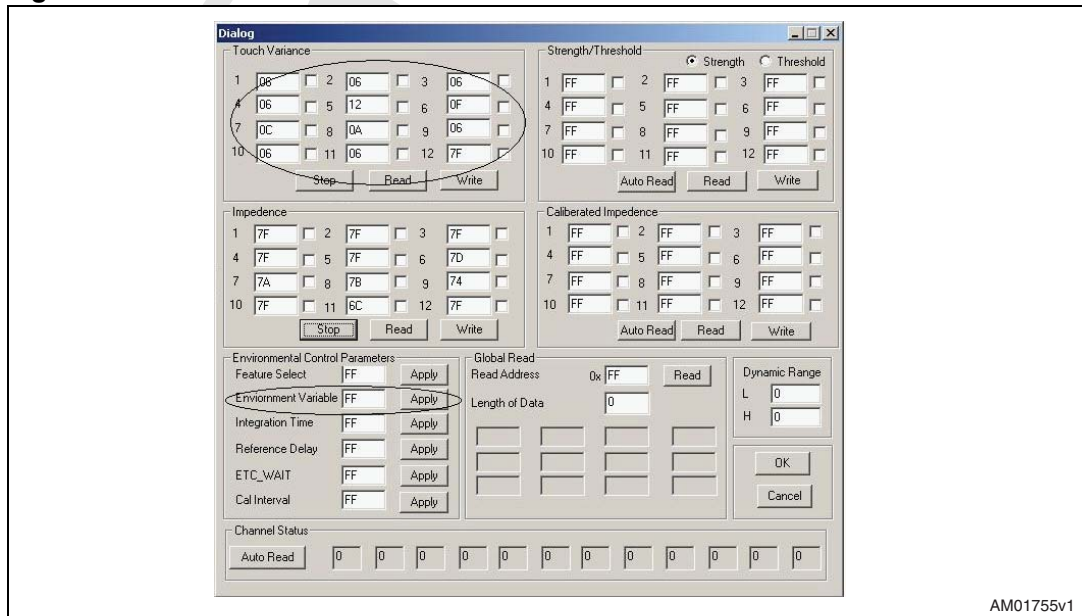
- Now if the impedance values of each channel are in the range as mentioned in the green section in below colored scale then it means that we have been successful in first step.

**Figure 21. Impedance values**



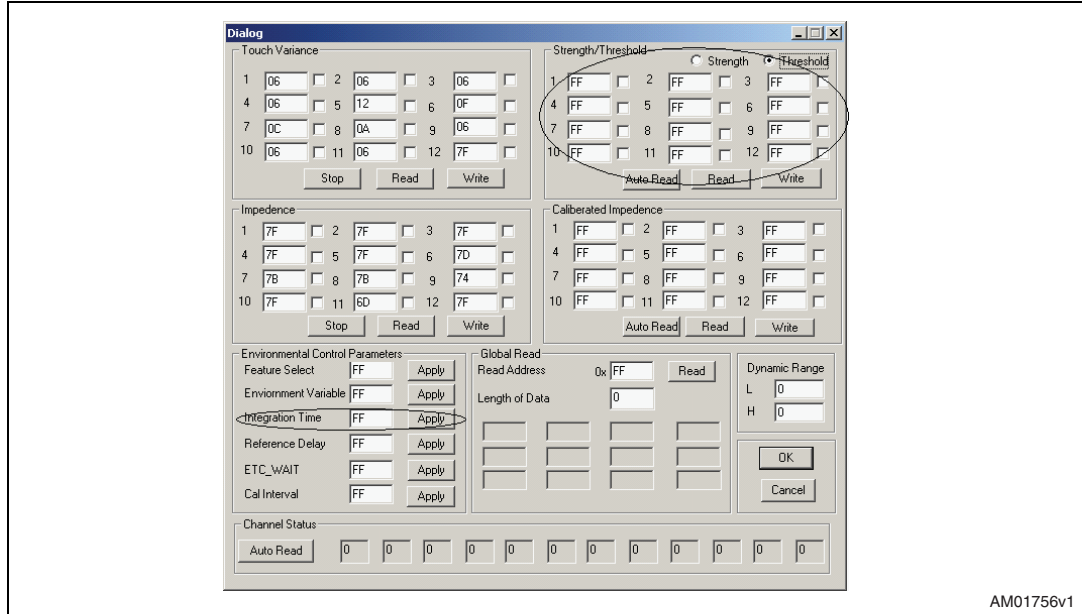
- The second is to fine tune the dynamic range of the impedances values of touch channel. Ideally the variance among the default impedance values should not be more than 15 -20. Less the dynamic range of the difference more better is the systems design. You can also add the capacitance on each touch channel to further fine tune this dynamic range.
- Once above steps are done then rests are the easier things to do. First of all define the Calibrated Impedances values as the default values of the impedances which you have come from the fine tuning of the impedances in step '1' and '2'.
- Next is the tuning of the environmental variable and touch variance on each channel. Generally the environmental variable values is in 4 - 8 range and touch variance values are in 10 -20 range. So depending on the applications you can set these values. [Figure 22](#) shows the field where we can set the touch variance and environmental variable.

**Figure 22. Touch variance and environmental variable**



- Next is the determination of strength threshold for each touch channel. The value in these fields can not be greater than the integration time. Circles area in fig shows the relevant section to change these values.

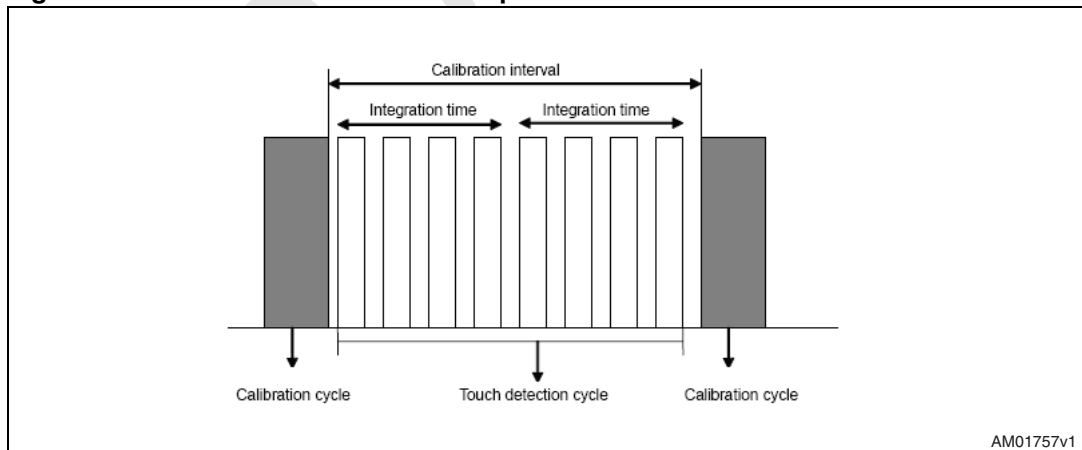
Figure 23. Strength threshold and integration time



The strength threshold parameter works along with the impedance value, touch variance and Integration time to determine the valid touch condition.

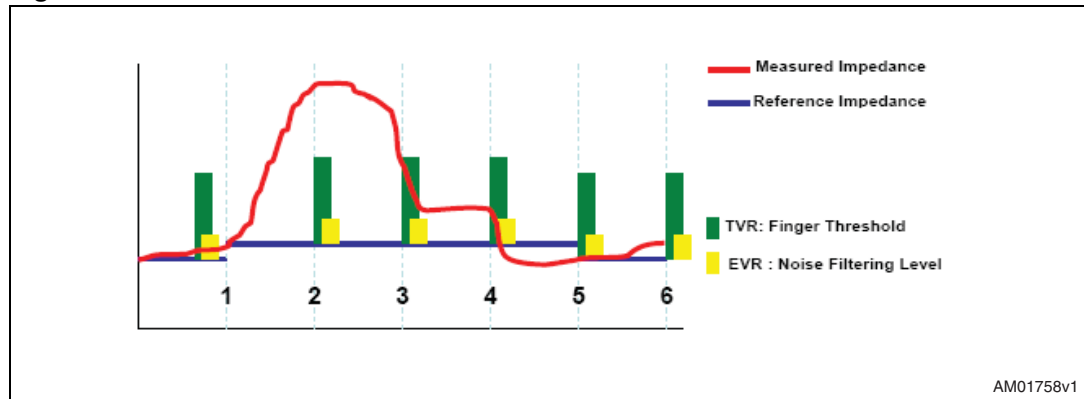
In run mode, S-Touch™ device is running either calibration cycle or touch detection cycle as shown in Figure 24. These two modes run in different clock frequencies.

Figure 24. S-Touch™ device normal operation



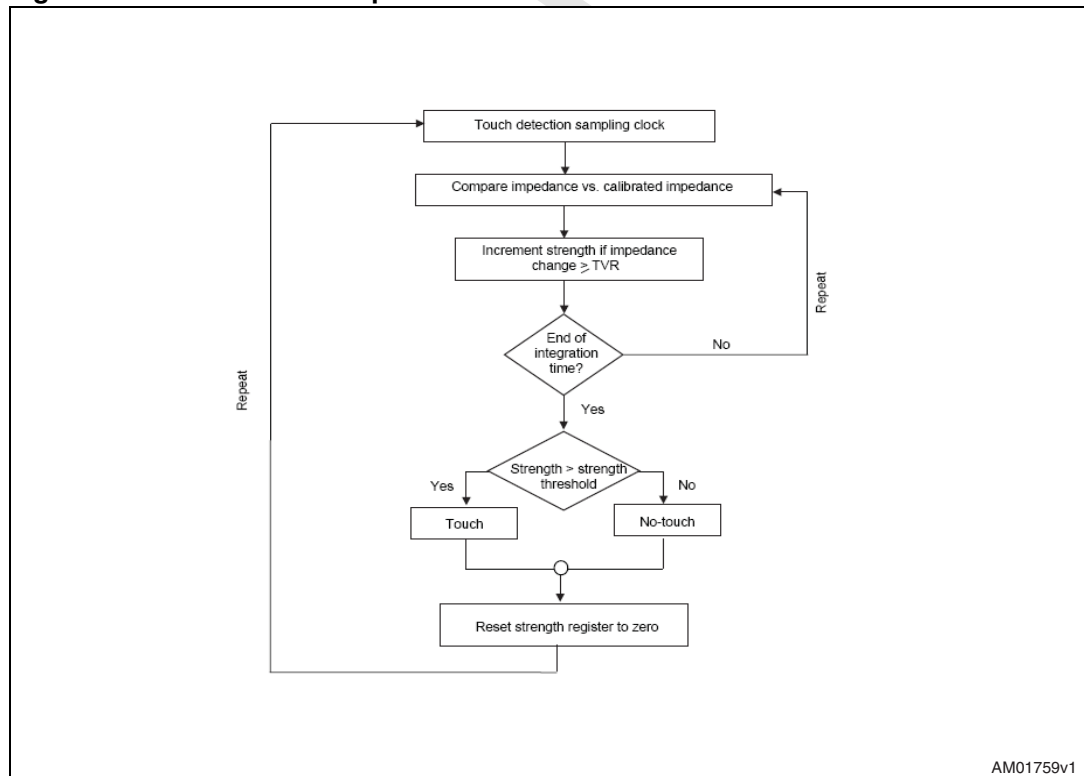
In touch detection mode, the S-Touch™ device performs the comparison of impedance values with the calibrated impedance and touch variance values to find out the touch condition across various touch channels.

Figure 25. Touch detection scenario



In *Figure 25*, one example is shown for this. Here for touch channel the Impedance change value of channel '2' is greater than its touch variance (TVR) value hence its strength is increment by 1. This comparison is done at each sensor clock till the number of clock is equal to Integration Time and at each clock strength count for a touch channel is incremented for number times it crosses its TVR value with respect to its calibrated Impedance (reference impedance). For valid touch detection, after the completion of touch detection cycle, the strength and strength threshold register of each touch channel is compared and the touch channel, whose Strength is greater than their corresponding strength threshold, are given as touch channel. The touch detection flow chart is as follows:

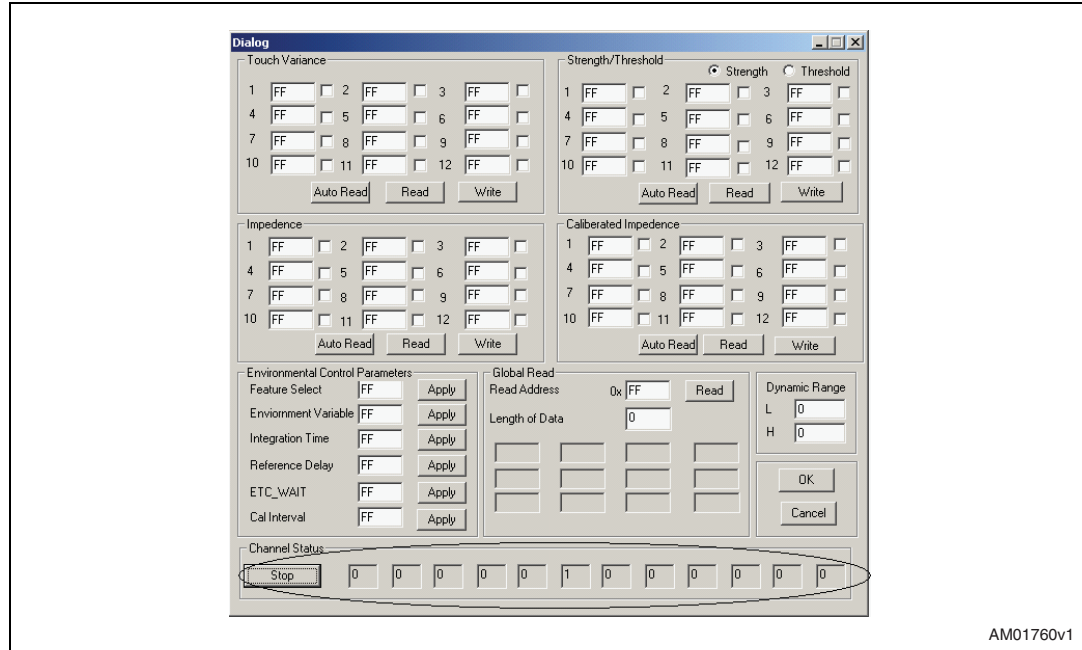
Figure 26. Touch detection process



Note: please remember that in case of S-Touch™, Impedance reading is read in the reverse order. 0 is the maximum value of impedance while TVR and EVR are to be taken in absolute manner.

You can see status for each channel touch condition in GUI as shown in the circled area in [Figure 27](#), if its Auto Read option is enabled. Here in the present case, touch channel '6' value is 1 indicating it to be in touched condition.

**Figure 27. Channel status**



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So S-Touch™ device filter out the noise output using the two-level of filtering. First level is comparison of Impedance with TVR and calibrated Impedance and second level is provided using strength values. Thus it provides a very robust output.

So depending on application, user can fine tune the values of strength threshold register values to toughen the touch condition for a noisy environment or make it easier for applications like where thick glass panel is used. So using this GUI, user can check its daughter board with respect to its application environment to determine proper values for these fields.

After these steps are done then your daughter board is in the ready conditions to be used. Here you can choose whatever I<sup>2</sup>C address you want to fix for the daughter board and integrate it with your systems.

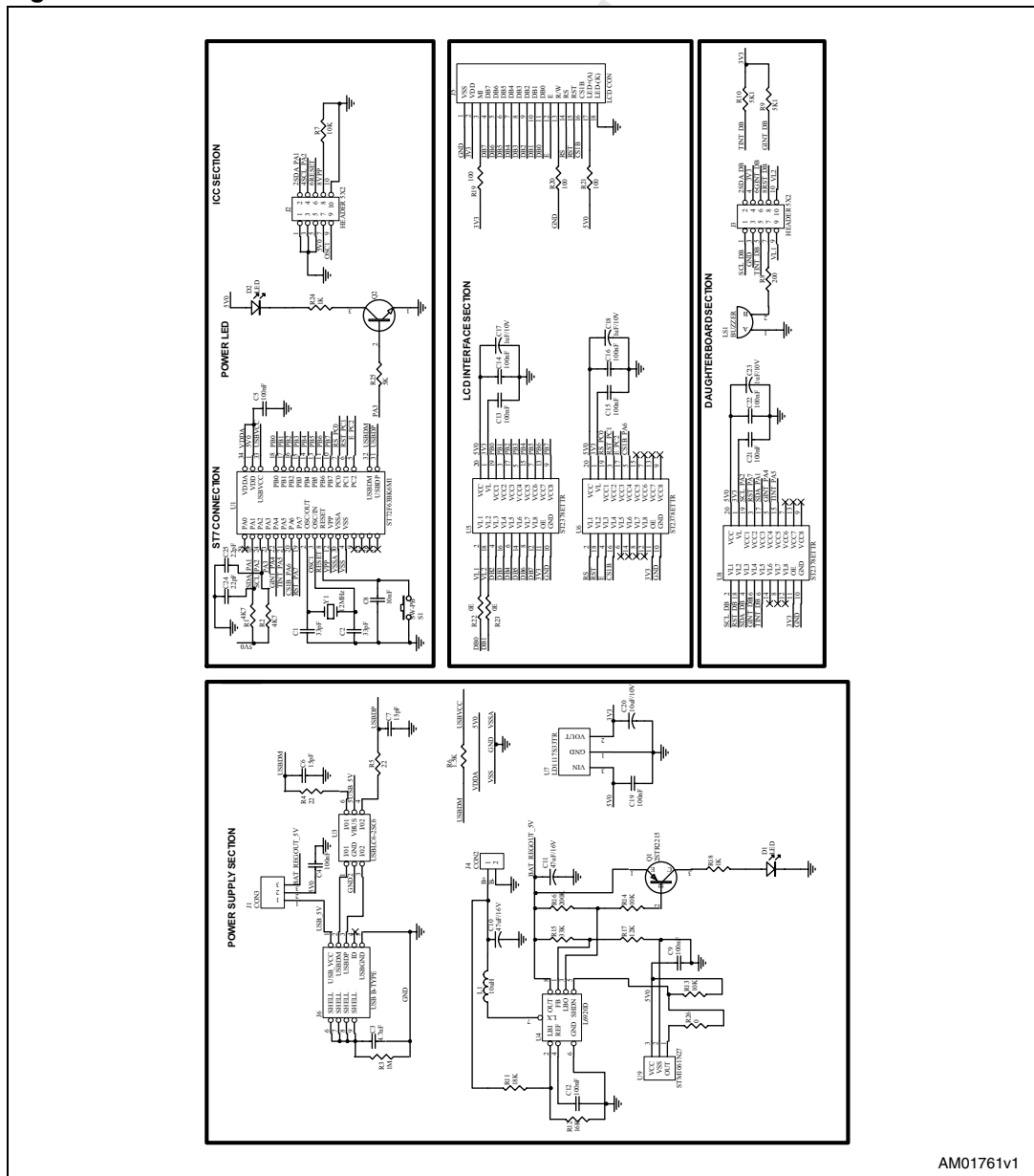
## Appendix A Schematics

### 3.1 Reference

1. AN2693: S-Touch™ devices: systems considerations
2. AN2733: S-Touch™ PCB and layout guidelines
3. STMPE1208S Datasheet.

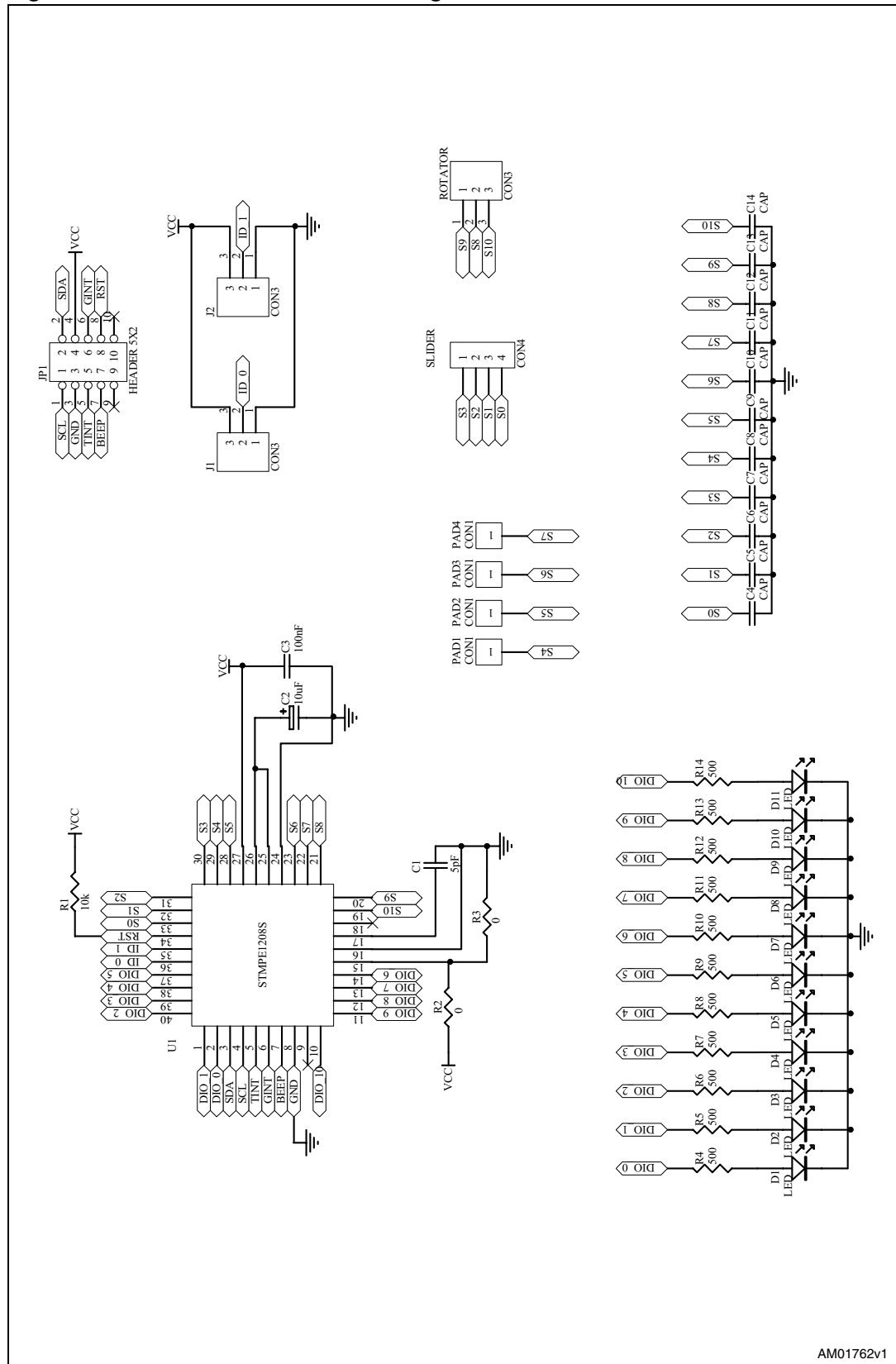
### 3.2 Demonstration board schematic

Figure 28. Schematic of S-Touch™ mother board



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Figure 29. Schematic of S-Touch™ daughter board



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## 4 Bill of material

Table 2. BOM

S. number	Reference designator	Quantity	Component description	Package	Manufacturer
<b>S-Touch mother board BOM</b>					
1	U1	1	ST72F63BK6M1	SO34	STMicroelectronics
2	U3	1	USBLC6-2SC6	SOT23-6L	STMicroelectronics
3	U4	1	L6920D	TSSOP8	STMicroelectronics
4	U5, U6, U8	3	ST2378ETTR	TSSOP20	STMicroelectronics
5	U7	1	LD1117S33TR	SOT-223	STMicroelectronics
6	U9 (not used)	1	STM1061N27WX6F	SOT-23	STMicroelectronics
7	Q1	1	2STR2215	SOT-23	STMicroelectronics
8	Q2	1	2STR1215	SOT-23	STMicroelectronics
9	Y1	1	12 MHz	CRYSTAL	Any
10	J1	1	CON3	IDC3	Any
11	J2	1	HEADER 5X2	IDC10B	Any
12	J3	1	HEADER 5X2	SMD HEADER (MALE)	SM Electronic Technologies P. Ltd.
13	J4	1	CON2	IDC2	Any
14	J5	1	LCD CON	LCD	Any
15	S1	1	RESET push button	SWITCH	Any
16	J6	1	USB B-TYPE	USB mini B-type	Any
17	D2	1	LED	3MMLED	Any
18	D1 (not used)	1	LED	SMD LED	Any
19	C17, C18, C23	3	1 $\mu$ F/10 V	C1206	Any
20	C3	1	4.7 nF	805	Any
21	C8	1	10 nF	805	Any
22	C20	1	10 $\mu$ F/10 V	C1206	Any
23	C6, C7	2	15 pF	805	Any
24	C1, C2	2	33 pF	805	Any
25	C10, C10	2	47 $\mu$ F/16 V	C1205	Any
26	C4, C5, C9, C12, C13, C14, C15, C16, C19, C21, C22	11	100 nF	805	Any
27	R22, R26, R23	3	0E	805	Any



Table 2. BOM (continued)

S. number	Reference designator	Quantity	Component description	Package	Manufacturer
28	R6	1	1.5 k $\Omega$	805	Any
29	R18, R24	2	1 k $\Omega$	805	Any
30	R3	1	1 M	805	Any
31	R1, R2	2	4K7	805	Any
32	R9, R10	2	5K1	805	Any
33	R25	1	5 k $\Omega$	805	Any
34	R7, R13, R14	3	10 k $\Omega$	805	Any
35	R17	1	12 k $\Omega$	805	Any
36	R12	1	16 k $\Omega$	805	Any
37	R11	1	18 k $\Omega$	805	Any
38	R4, R5	2	22	805	Any
39	R15	1	33 k $\Omega$	805	Any
40	R15	1	33 k $\Omega$	805	Any
41	R19, R20, R21	3	100 $\Omega$	805	Any
42	R8	1	200 $\Omega$	805	Any
43	R16	1	200 k $\Omega$	805	Any
44	L1	1	10 $\mu$ H	Inductor	Any
45	LS1 (not mounted)	1	Buzzer	Buzzer	Any
46	Mounted on LCD con1	1	64X128MONO BERG 2 WAY	Mono Chrome LCD	Display tech Ltd
<b>S-Touch™ daughter board BOM</b>					
1	U1	1	STMPE1208SQTR	QFN40	STMicroelectronics
2	J2	1	CON3	HEADER3	Any
3	J1	1	CON3	HEADER3	Any
4	JP1	1	HEADER 5X2	SMD HEADER (FEMALE)	SM Electronic Technologies P. Ltd.
5	D1, D2, D3, D4, D5, D6, D7, D8, D9, D10, D11	11	LED	0805_H	
6	C1	1	5 pF	804	Any
7	C2	1	10 $\mu$ F	C1206	Any
8	C3	1	100 nF	805	Any
9	C4, C5, C6, C7, C8, C9, 10, C11, C12, C13, C14	11	CAP (between 1 - 3 pf)	805	Any

Table 2. BOM (continued)

S. number	Reference designator	Quantity	Component description	Package	Manufacturer
10	R2, R3	2	0E	805	Any
11	R1	1	10 k $\Omega$	805	Any
12	R4, R5, R6, R7, R8, R9, R10, R11, R12, R13, R14	11	500	805	Any

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## 5 Revision history

**Table 3. Document revision history**

Date	Revision	Changes
30-Oct-2008	1	Initial release

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