UM1002
User manual

STEVAL-ICB008V1 touch-sensing software library demonstration kit based on STM8S207S8

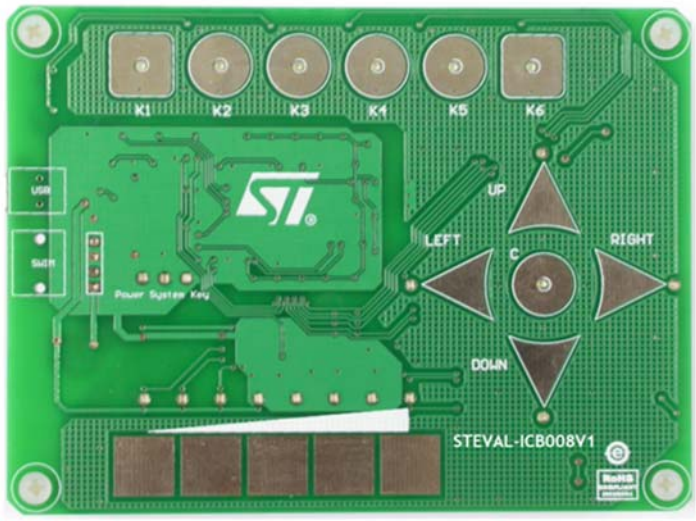
Introduction

This touch-sensing software library demonstration kit is based on STMicroelectronics' 8-bit microcontroller STM8S207S8. With this kit, users can familiarize themselves with the functionality and the performance of STMicroelectronics' capacitive touch-sensing solution. This kit is driven by software open library at http://www.st.com/internet/mcu/subclass/1428.jsp.

This is the complete, free source code to transform any 8-bit STM8 microcontroller into a capacitive touchkey controller.

The STEVAL-ICB008V1 demonstration kit consists of 3 parts, a demonstration board, a PC GUI program, and a USB cable (standard-A to mini-B). Powered by the PC USB port, the demonstration board can be demonstrated in standalone. There are 19 LEDs indicating touchpad information for 6 keys (K1, K2, K3, K4, K5 and K6), 5 crosses (C, UP, LEFT, DOWN and RIGHT) and one (5 electrodes) slider and another 3 LEDs on the board indicate the system general status (power, system, and key). With the PC GUI program, the STM8S RC touch solution provides a simple platform to monitor more detailed operating information and configure values of critical touch-sensing parameters in applications.

Figure 1. STM8S207S8 RC touch solution



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1 General description

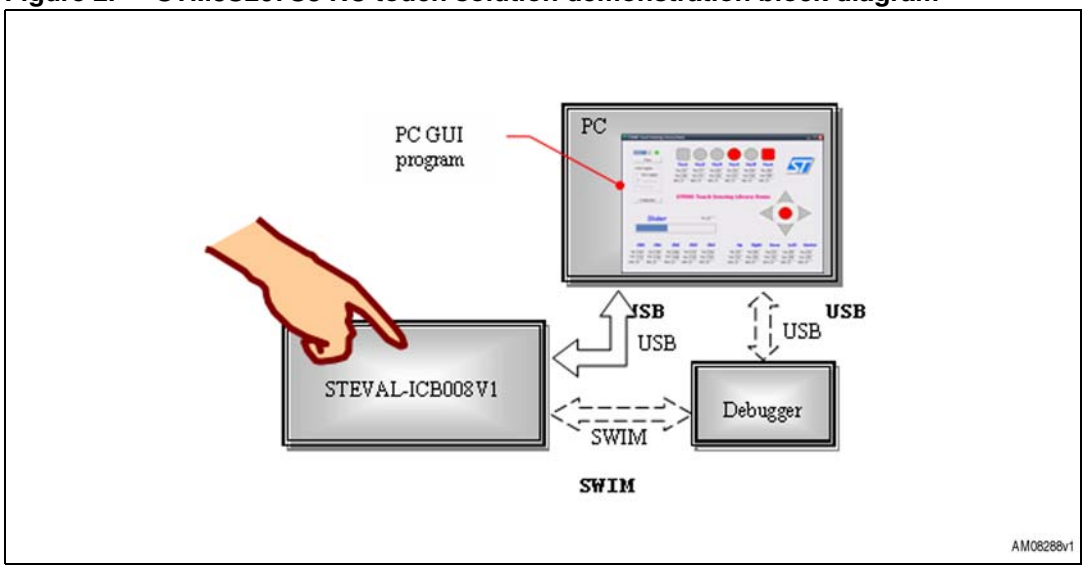
1.1 Advantages of STM8S RC touch solution

- Small outline with high density demonstration functions
- Easy demonstration kit which is powered by a USB port, additional power supply is not required
- Two demonstration modes, offline and online
- Board functions are driven by the library which can be configured through the GUI
- Touchpad information logs on PC
- SWIM port is reserved for debug use.

1.2 Architecture

A block diagram of the STM8S207S8 RC touch solution demonstration is illustrated in *Figure 2*, and contains a demonstration board, a PC GUI program, and a standard-A to mini-B USB cable. The kit can be used in standalone (offline mode), or used along with the PC GUI program (online mode) for advanced demonstration.

Figure 2. STM8S207S8 RC touch solution demonstration block diagram



In offline mode, the board is connected to the PC and the USB cable provides the power. By touching each touchpad on the board, the corresponding LED on the board indicates the touch-sensing status.

In online mode, the USB cable not only provides power supply to the demonstration board but also data transform. Therefore, the USB driver needs to be installed prior to starting communication. Thanks to the PC GUI program, some detailed information can be real-time displayed or saved to the PC. Some critical configurations (e.g. threshold, de-bounce filter, etc.) are able to be set to the board without entering the debugging procedure, and effected immediately after setting is done through the PC GUI.

There is a reserved SWIM port, shown in *Figure 2*. The configuration between the debugger is indicated by dashed arrows. This configuration is used to perform real-time debug, or modify application firmware.

Recommended tools:

- Debugger: resonance RLink debugger/programmer for ST microcontrollers. And ST-Link debugger and Flash programmer for STM8 and STM32 microcontrollers.
- Development environment: ST MCU Toolset with ST visual develop (STVD) IDE and ST visual programmer (STVP) programming interface.

2 Getting started with STM8S207S8 RC touch solution

2.1 Demonstration kit checklist

The STM8S207S8 RC touch solution contains:

- STM8S207S8 RC touch board
- USB cable (standard-A to mini-B)
- Material disc including PC GUI program “STM8S RC Touch Demo.exe”, USB driver “CP210x_VCP_Win98SE.exe”, and user manual (this document).

2.2 Demonstration board description

Figure 3 shows the top view of the demonstration board and *Figure 4* shows the bottom view.

Figure 3. STM8S207S8 RC touch board top view

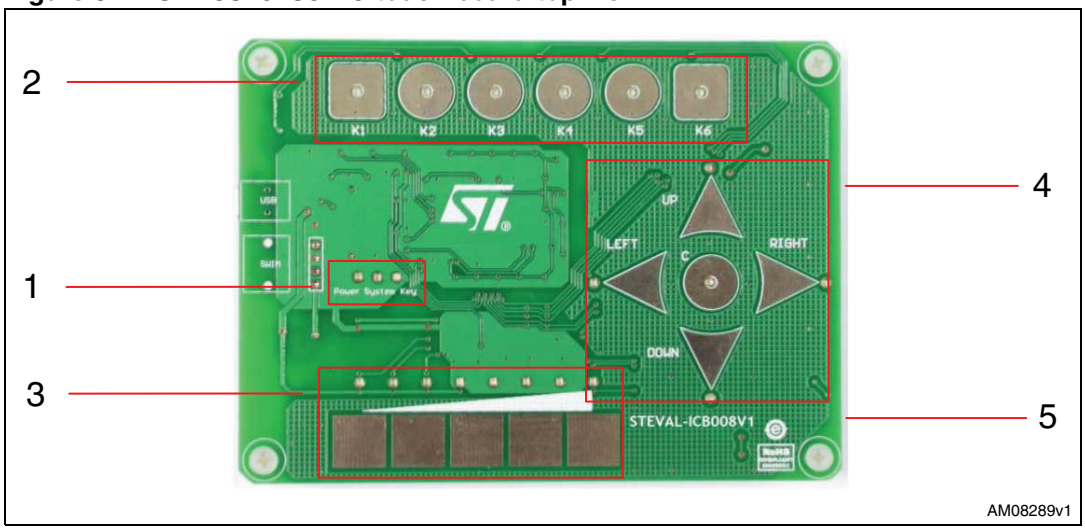
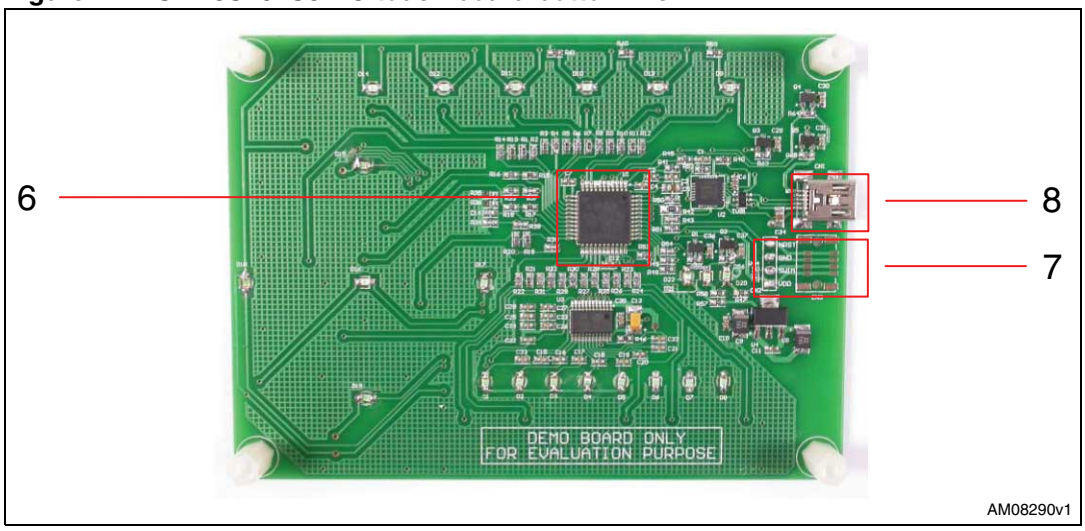


Figure 4. STM8S207S8 RC touch board bottom view



Board description

1. System status indication LEDs
   - Power indicator illuminates once the board is powered. The power is obtained through the USB cable
   - System indicator blinks with 1 Hz rate when microprocessor is working. The blinking rate slows down when MCU enters low power mode
   - Key indicator illuminates once the key, slider, or cross direction touching has been detected. Light is OFF when system has been reset
2. Key1~Key6

   There is an indication LED inside each key electrode. Every touch event on Key1~Key6 toggles LED status. The LED lights ON and OFF correspond with key status.
3. Slider

   The slider consists of five electrodes, which are, from left to right, channel 0, channel 1, channel 2, channel 3, and channel 4 respectively (refer to *Figure 3* and *Section 3.2.1*).

   There are 8 indication LEDs above the electrodes displaying the current position of the slider.

Note: The slider starts from the middle of the first electrode (channel 0) and ends up in the middle of the fifth electrode (channel 4). Outside this area, the slider does not detect a position change.

4. Cross keys

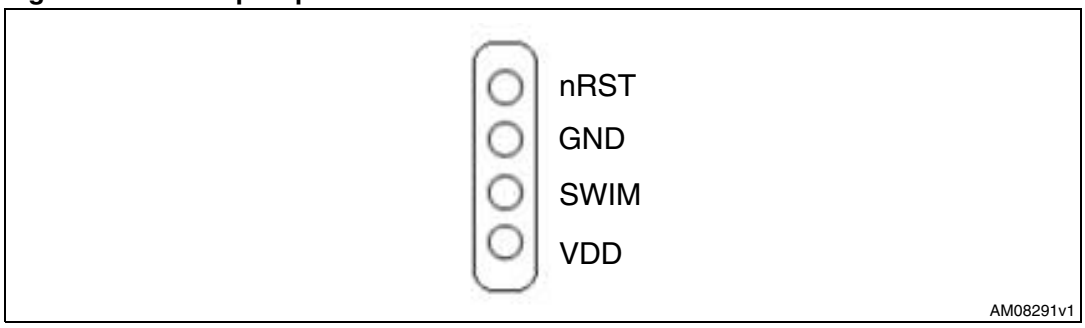
   The center key has an indication LED inside the key electrode. Every touch on the center key event toggles the LED status. The rest of the cross keys have their own LED indicator near the electrode. Every touch event on those keys toggles the LED status. The LED lights ON and OFF correspond with key status.
5. Dielectric

   Dielectric is a 1.5 mm thickness Plexiglas sheet, which is used to isolate the user's finger from the electrode on the PCB. It can be replaced by another dielectric with a different thickness or material, and some parameters (e.g. threshold) need to be tuned through the PC GUI program. Please refer to the AN2869 application note.
6. MCU

   STM8S207S8, STMicroelectronics' standard 8-bit microprocessor.
7. SWIM port

   The SWIM port is reserved for debug use. Please refer to *Figure 5* for the pin assignment.

Figure 5. SWIM port pin bottom view



8. USB connector

   The USB connector is a mini-B receptacle for USB standard-A to mini-B cable.

3 PC GUI program

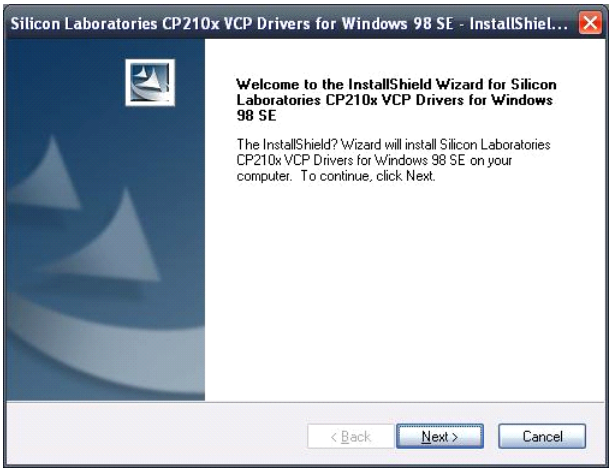
A PC GUI program named “STM8S RC Touch Demo.exe” is designed to demonstrate more detailed information of the demonstration kit, such as signal level, reference level, etc. It also provides an interface for the user to configure some critical parameters of RC touch directly through the USB connection without reloading the firmware under debug mode.

3.1 Driver installation

Communication between the board and PC is achieved by a USB to UART bridge controller CP2102 manufactured by Silicon Laboratories Inc. Before starting communication, a driver needs to be installed on Windows®. Please follow the procedures below:

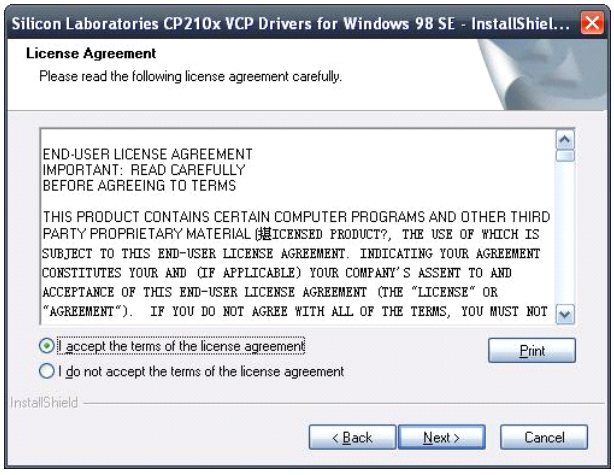
- Step 1: run “CP210x_VCP_Win98SE.exe” in the disc, and click “Next” to proceed.

Figure 6. Driver installation step 1



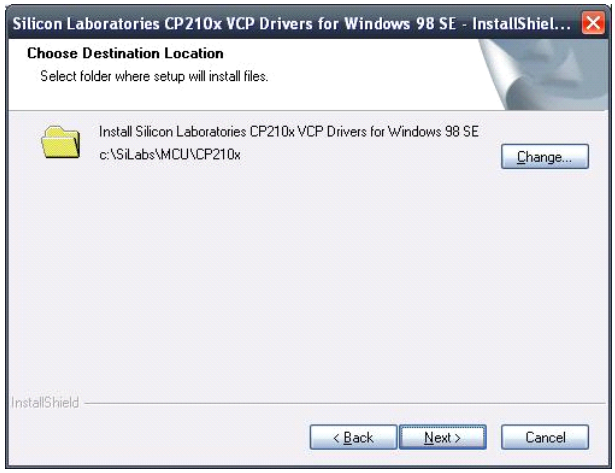
- Step 2: accept the license agreement and click “Next” to proceed.

Figure 7. Driver installation step 2



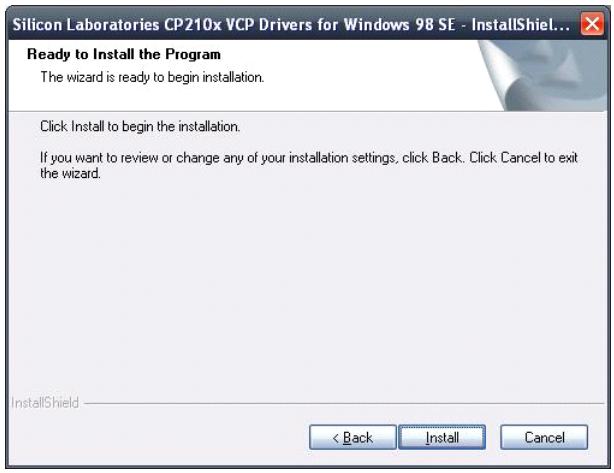
- Step 3: choose the installation directory and click “Next” to proceed. The default directory is “c:\SiLabs\MCU\CP210x”.

Figure 8. Driver installation step 3



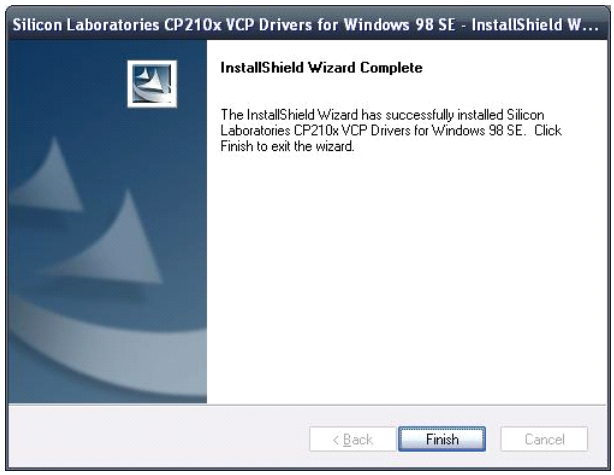
- Step 4: click “Install” to proceed.

Figure 9. Driver installation step 4



- Step 5: click “Finish” to exit installation program.

Figure 10. Driver installation step 5



- Step 6: connect the demonstration board to the PC with the USB cable. New hardware is detected.

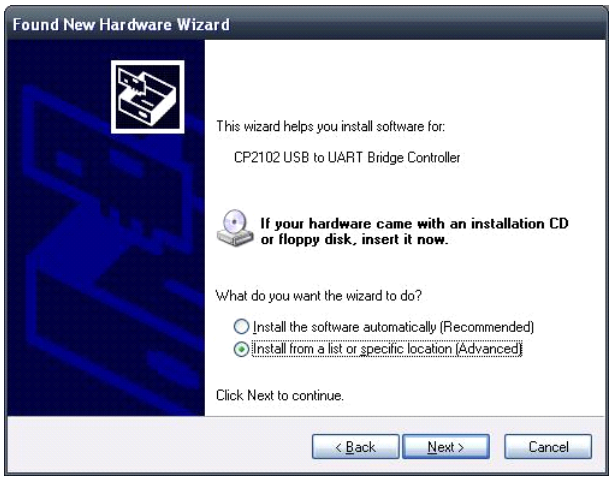
Figure 11. Driver installation step 6

- Step 7: choose “No, not this time” in “Found New Hardware Wizard”, and click “Next” to proceed.

Figure 12. Driver installation step 7

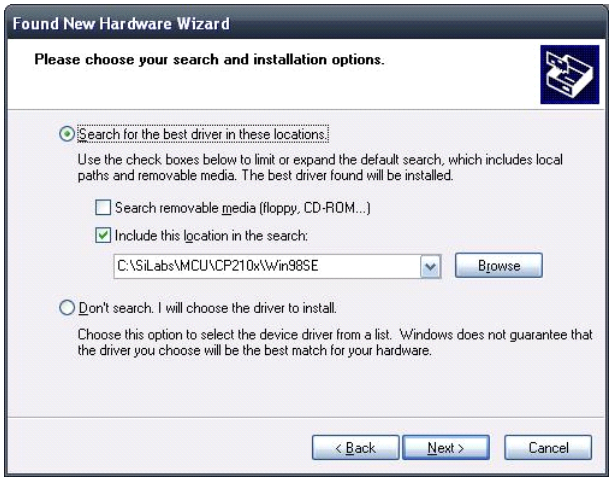
- Step 8: choose “Install from a list or specific location (Advanced)”, and click “Next” to proceed.

Figure 13. Driver installation step 8



- Step 9: browse the directory where the driver is installed, and click “Next” to proceed.

Figure 14. Driver installation step 9



- Step 10: install “CP210x USB Composite Device” by clicking “Continue Anyway”.

Figure 15. Driver installation step 10

- Step 11: click “Finish” to complete driver installation for “CP210x USB Composite Device”.

Figure 16. Driver installation step 11

- Step 12: another new hardware is detected.

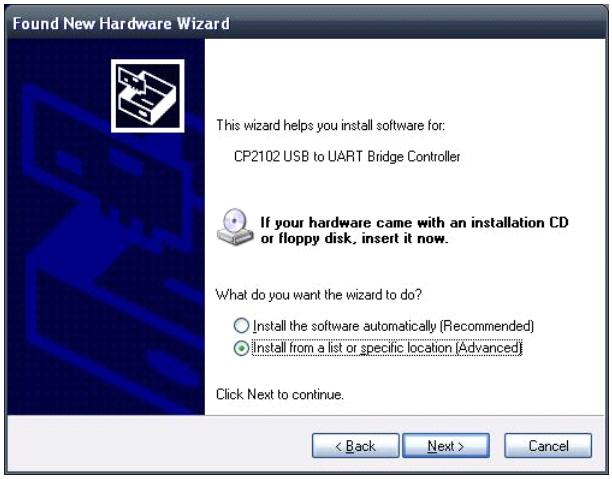
Figure 17. Driver installation step 12

- Step 13: choose “No, not this time” in “Found New Hardware Wizard”, and click “Next” to proceed.

Figure 18. Driver installation step 13

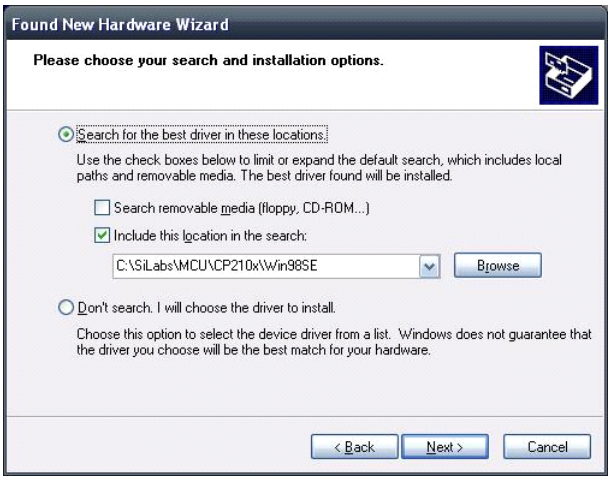
- Step 14: choose “Install from a list or specific location (advanced)”, and click “Next” to proceed.

Figure 19. Driver installation step 14



- Step 15: browse the directory where the driver is installed, and click “Next” to proceed.

Figure 20. Driver installation step 15



- Step 16: install “CP210x USB to UART Bridge Controller” by clicking “Continue Anyway”.

Figure 21. Driver installation step 16

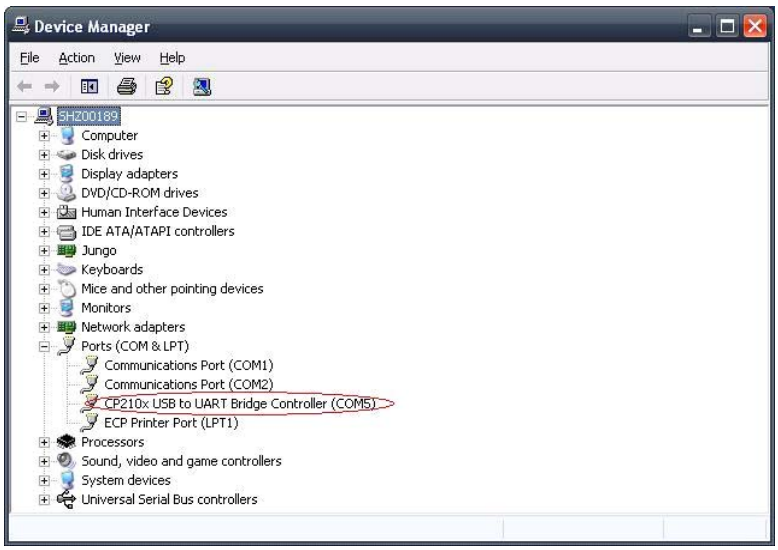
- Step 17: click “Finish” to complete driver installation for “CP210x USB to UART Bridge Controller”.

Figure 22. Driver installation step 17

- Step 18: launch device manager (Path: My Computer → Properties → Hardware → Device Manager) and expand “Ports (COM and LPT)” as shown in *Figure 23*. A virtual COM port named “CP210x USB to UART Bridge Controller” is listed if the driver is successfully installed. The port number is assigned by Windows automatically (or reassigned manually).

Note: Never assign a number exceeding 8, otherwise the PC GUI program is not able to recognize the COM port correctly.

Figure 23. Driver installation step 18



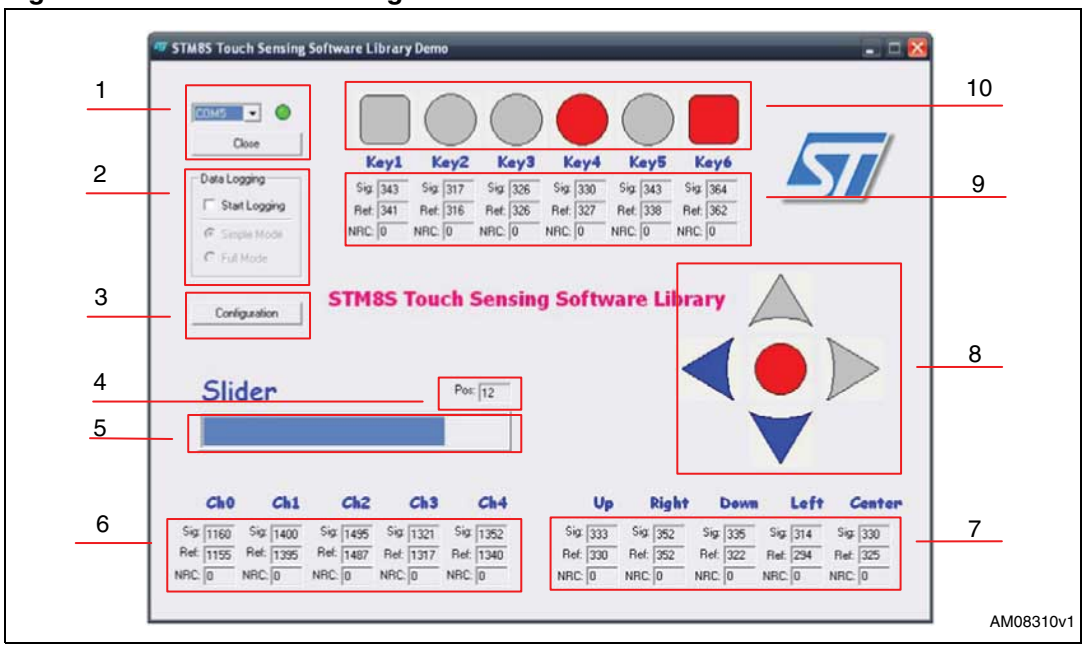
3.2 PC GUI program

Before running the PC GUI program, make sure the driver is properly installed, and the USB cable is well connected.

3.2.1 Main dialog

Run “STM8S RC Touch Demo.exe”. The main dialog program is illustrated in *Figure 24*.

Figure 24. PC GUI main dialog



Main dialog layout

1. Communication setting

   After choosing the virtual COM port listed in “Device Manager” (*Figure 23*), the button is used to open or close the port. The LED icon turns on (green) to indicate that the port is opened. When the port is not opened, the LED icon turns off (gray). Make sure the virtual COM port has been recognized before the PC GUI program is opened. Otherwise the port is not displayed in the dropdown list.

2. Data logging

   Data logging is used to record events regarding touch-sensing. Of course, some unexpected touching or system status change due to environmental conditions is captured by the data logging function. Simple mode records only touch/release events and the slider position changing events. However, full mode records all touch-sensing information received from the demonstration board.

   Data is saved in “STM8S RC Touch Demo_Simple.log” and “STM8S RC Touch Demo_Full.log” respectively, which are located in the same directory as the PC GUI

program. It is recommended to open the log files with Windows Excel. The record format is described in *Appendix A*.

3. System configuration

   Press the “Configuration” button to launch a configuration dialog which is described in *Section 3.2.2*.

4. Slider position

   The current position of the slider bar is indicated by this number.

5. Slider illustration

   The current position of the slider bar is indicated by this illustration.

6. Slider touch-sensing information

   The information is obtained from electrode pads Ch0, Ch1, Ch2, Ch3 and Ch4.

   – “Sig” stands for signal level. The number shows present charging time to those channels
   – “Ref” stands for reference level. The number shows judgment benchmark of a touch event. Normally, a signal is not less than the sum of the reference level. The detected touch events are treated as valid
   – “NRC” stands for noise rejection counter. During each IO acquisition, NRC increases by 1. The MCU detects an incorrect measure once signal presence is out of guard band

7. Cross touch-sensing information

   The information is obtained from electrode pads up, down, left, right, and center. The meaning of the table content of sig, ref, and NRC is the same as “slider touch-sensing information”.

8. Cross illustration

   With each touch of cross keys, the corresponding icon changes color. For the center key the icon changes to red. For the direction keys the icon changes to blue. If no touch is detected, the icon remains gray.

9. Key touch-sensing information

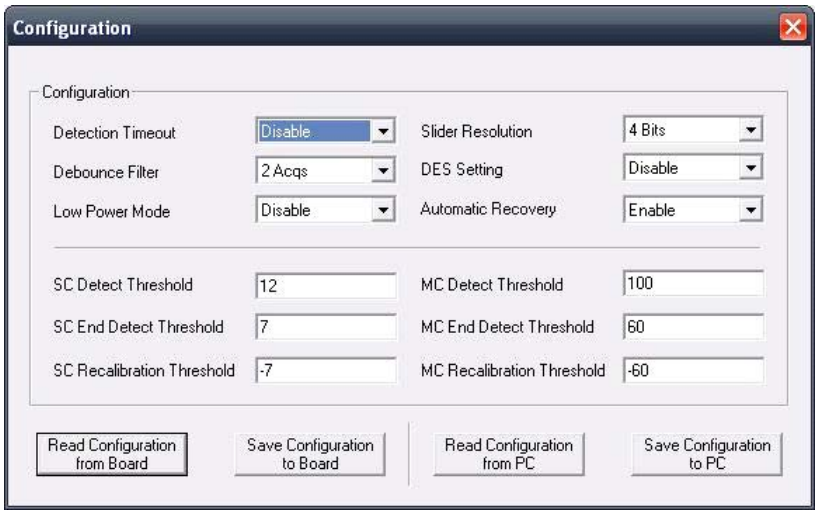
   The information is obtained from electrode pads Key1, Key2, Key3, Key4, Key5, and Key6. The meaning of the table content is the same as slider touch-sensing information.

10. Key illustration

    Once a touch of the Key electrode is detected, the corresponding icon turns to red. If no touch of the key is detected, the icon remains gray.

3.2.2 Configuration dialog

Figure 25. PC GUI configuration dialog



Configuration Parameters

1. Detection Timeout

   This feature enables a counter per key to set a maximum time for one detection process. If a key stays in detected state for this duration, the system launches a re-calibration process. As a consequence, the key is no longer detected. This feature avoids blocking the system in detected state due to unexpected external perturbations.

2. De-bounce filter

   The programmable filters require consecutive detections over a number of readings for a touch to be confirmed. This is used during key detection, key end detection and before entering the calibration state. A counter is set at the initialization state and decremented at each state machine loop. When the value reaches 0, the next state is reached. For instance, when the de-bounce filter is set to “2 Acqs”, it means that the total number of acquisitions for verifying a key's state is 3 (2+1).

3. Low power mode

   In order to save the average current consumption of the MCU this feature enables the STM8S207S8 to enter into active halt mode between proceeding touch-sensing routines. For instance, “8 mSec” means STM8S207S8 is in active halt for 8 milliseconds, and then wakes up for another touch-sensing routine.

   On the other hand, in the low power mode, key response is consequently slowed down. However, after a touch is detected, STM8S207S8 stays in run mode for a while (5 seconds). If no other touch is detected, STM8S207S8 once more returns to low power mode.

   When entering into low power mode, the indication LED “System”, on the demonstration board, slows down its blinking frequency, and the refreshing rate of the PC GUI program also decreases.

Note: Do NOT try to configure the demonstration board when it is in low power mode, as STM8S207S8 cannot receive data properly during active halt mode.

4. Slider resolution

   Slider resolution defines the default resolution for multi-channel keys.

   This parameter can take a value between 1 (1-bit resolution) and 8 (8-bit resolution). A low value results in a low resolution and is less subject to noise. A high value results in a high resolution and is more subject to noise.

   For instance, if slider resolution is set to “4 bits”, the slider position ranges from 0 (2^0) to 15 (2^4-1).

5. DES setting

   The detection exclusion system (DES) is to prevent several keys from responding to a single touch.

   DES locks all keys of the same group in the untouched state once the first key of the group is detected. The locking key must be released first for any other key of the group to be reported as touched.

6. Automatic recovery

   RC touch reads the RC charging time and sense capacitance variation when a key is touched. If the charging time shows as too long or too short, RC touch sets the corresponding key to error state, and stops the key from being detected. The key is apparently “dead”.

   If the causes (water film, electrical interference, etc.) of the abnormality are removed, automatic recovery function resets the error state and resumes the function.

7. SC detect threshold

   SC detect threshold defines the detection threshold value for the single-channel keys. The key is determined as “detected” if the changed value is greater than this threshold.

   This parameter can take a value varying from 1 to 127. A low value results in high sensitivity during the detection. A high value results in low sensitivity during the detection.

8. SC end detect threshold

   SC end detect threshold defines the end-detection threshold value for the single-channel keys. The key is determined as “not detected” if the changed value is lower than this threshold.

   This parameter can take a value varying from 1 to 127. A low value results in low sensitivity during the un-detection. A high value results in high sensitivity during the un-detection.

9. SC recalibration threshold

   SC recalibration threshold defines the recalibration threshold value for the single-channel keys. The key is recalibrated if the changed value is lower than this threshold.

   This parameter can take a value varying from -1 to -128. A low absolute value results in high sensitivity for the recalibration. A high absolute value results in low sensitivity for the recalibration.

10. MC detect threshold

    The dialog box shows the detect threshold for multi-channel keys. The parameter setting is the same as the SC detect threshold.

11. MC end detect threshold

    The dialog box shows the end detect threshold value for multi-channel keys. The parameter setting is the same as the SC end detect threshold.

12. MC recalibration threshold

    The dialog box shows the recalibration threshold value for multi-channel keys. The parameter setting is the same as the SC recalibration threshold.

Action buttons description

1. Read configuration from board

   After pressing this button, all the 12 configuration parameters, described above in *Configuration Parameters*, are loaded to the current dialog box from the demonstration board. A pop-up box (in *Figure 26*) shows that the operation is successful.

Figure 26. Pop-up box for successful reading operation from demonstration board

2. Save configuration to board

   After pressing this button, all the 12 configuration parameters described in Configuration Parameters are loaded to the demonstration board from the current dialog.

   A pop-up box (in *Figure 27*) shows the operation is successful.

Figure 27. Pop-up box for successful writing operation to demonstration board

3. Read configuration from PC

   After pressing this button, all the 12 configuration parameters described in Configuration Parameters are loaded to the demonstration board from the file “STM8S RC Touch Demo.ini”, if present.

   Make sure that the “STM8S RC Touch Demo.ini” file is located in the same directory as the PC GUI program.

4. Save configuration to PC

   After pressing this button, all the 12 configuration parameters described in Configuration Parameters are saved in the file “STM8S RC Touch Demo.ini” from the demonstration board.

   The saved file “STM8S RC Touch Demo.ini” is located in the same directory as the PC GUI program.

Appendix A Data format of log files

Simple logging mode

The data format of “STM8S RC Touch Demo_Simple.log” is organized below in *Table 1*.

Table 1. Data format of “STM8S RC Touch Demo_Simple.log”

A	B	C	D
Date	Time	Key name	Key status(1)

1. Key status: touched/released for Key1~Key6 and cross keys; slider position for slider.

Full logging mode

The data format of “STM8S RC Touch Demo_Full.log” is organized in *Table 2*, and *3*.

Table 2. Data format of “STM8S RC Touch Demo_Full.log” for Key1~Key6 and Cross

A	B	C	D	E	F	G	H
Date	Time	Key name	Key status	Signal level	Reference level	NRC	LED status(1)

1. LED status: status of indicative LEDs on the demonstration board is not available for up, left, down, and right.

Table 3. Data format of “STM8S RC Touch Demo_Full.log” for Slider

A	Date	**H**	Reference level (Ch0)	**O**	NRC (Ch2)
B	Time	**I**	NRC (Ch0)	**P**	Signal level (Ch3)
C	Key name	**J**	Signal level (Ch1)	**Q**	Reference level (Ch3)
D	Position	**K**	Reference level (Ch1)	**R**	NRC (Ch3)
E	UnScaled position(1)	**L**	NRC (Ch1)	**S**	Signal level (Ch4)
F	Slider resolution	**M**	Signal level (Ch2)	**T**	Reference level (Ch4)
G	Signal level (Ch0)	**N**	Reference level (Ch2)	**U**	NRC (Ch4)

1. UnScaled position: RC touch always calculates a raw position of 8-bit resolution ranging form 0 to 255, and then converts it to position information according to slider resolution.

In full logging mode, each record value is saved in Key1 → Key2 → Key3 → Key4 → Key5 → Key6 → Up → Left → Down → Right → Center → Slider.

Appendix B Schematics

Figure 28. LED indication circuit

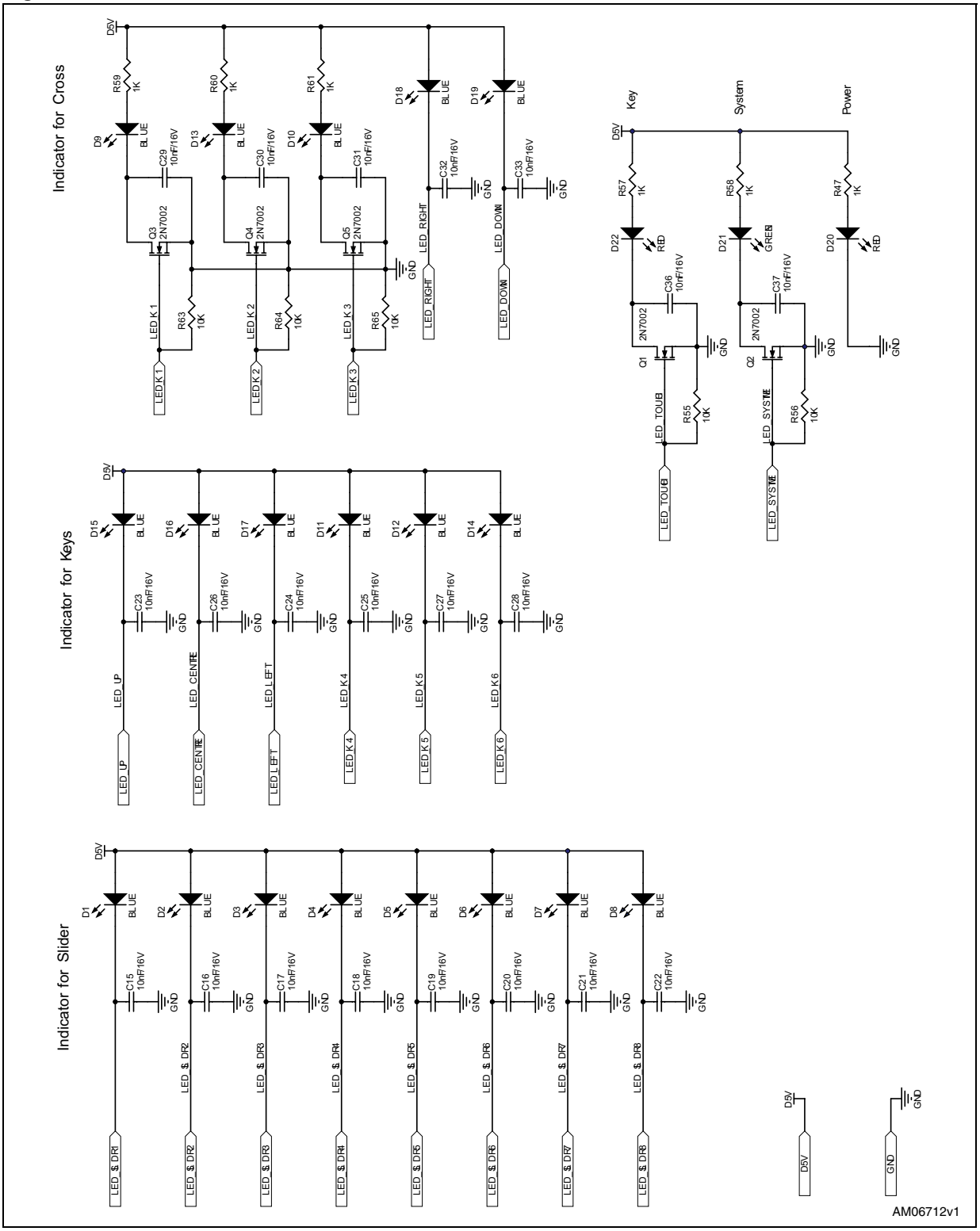


Figure 29. Touch key and driven shield

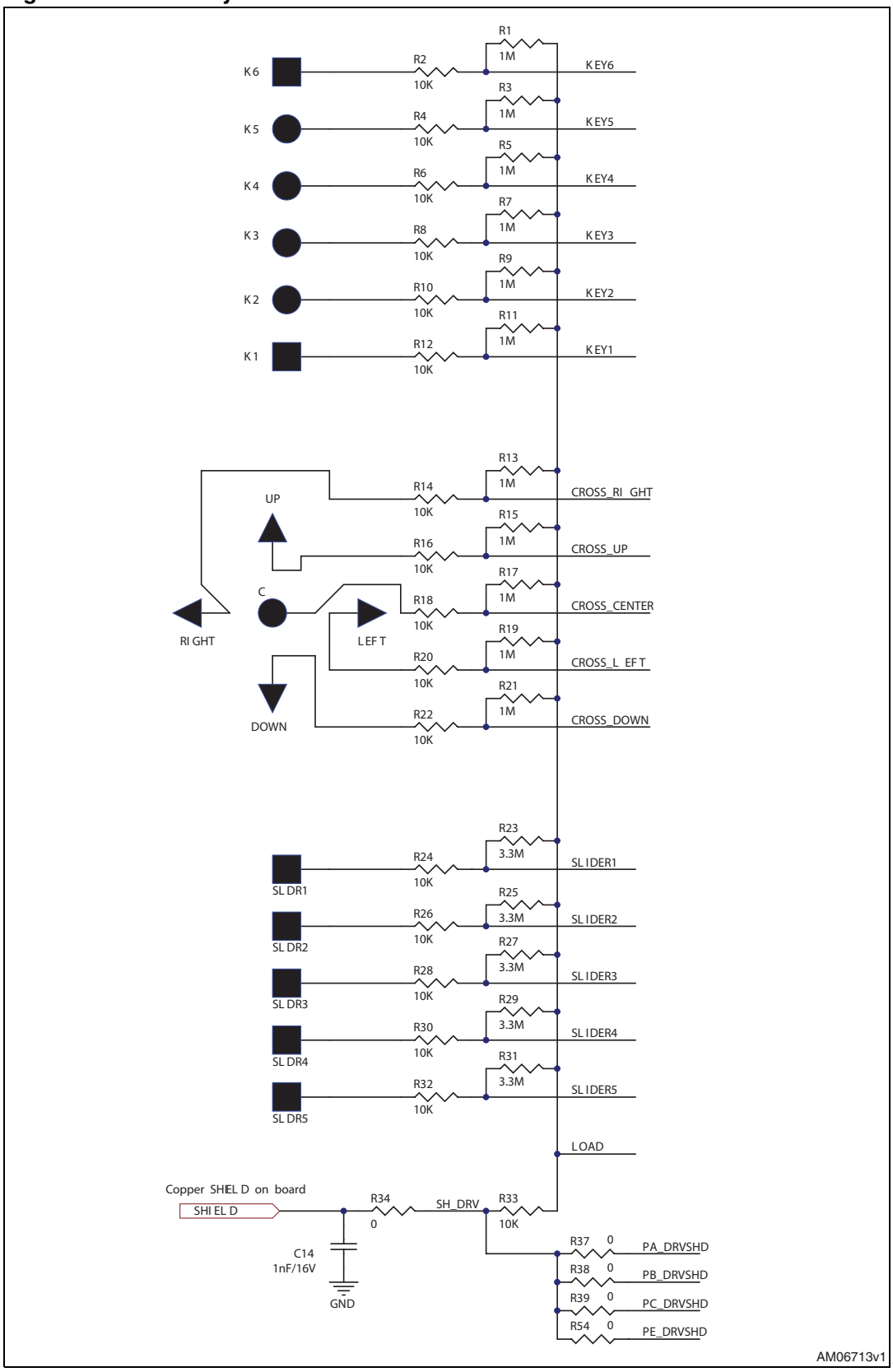


Figure 30. MCU and USB to UART

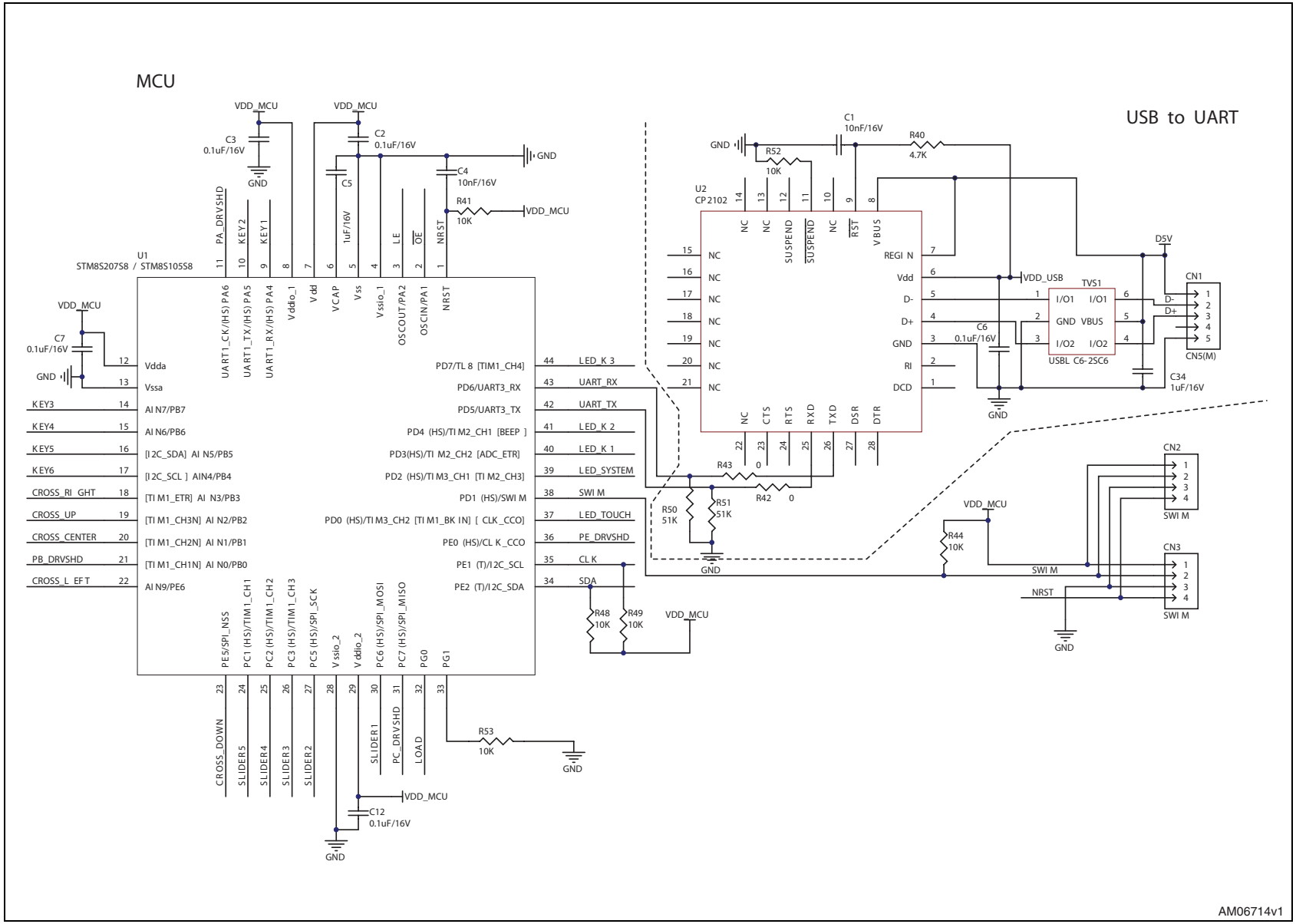


Figure 31. Power supply +5 V and +3.3 V

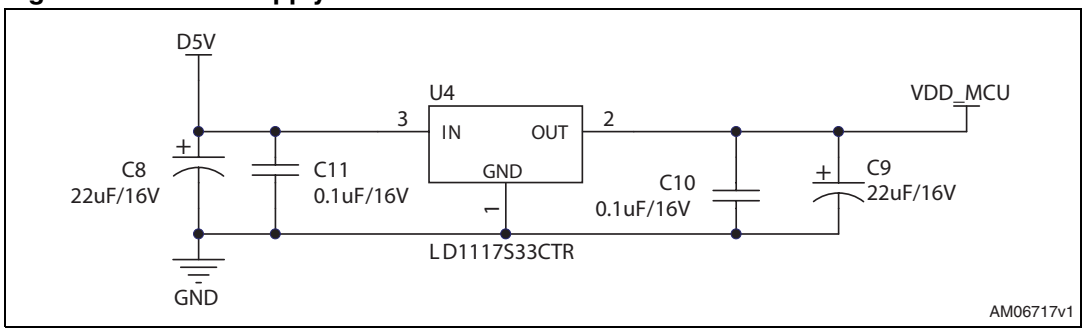
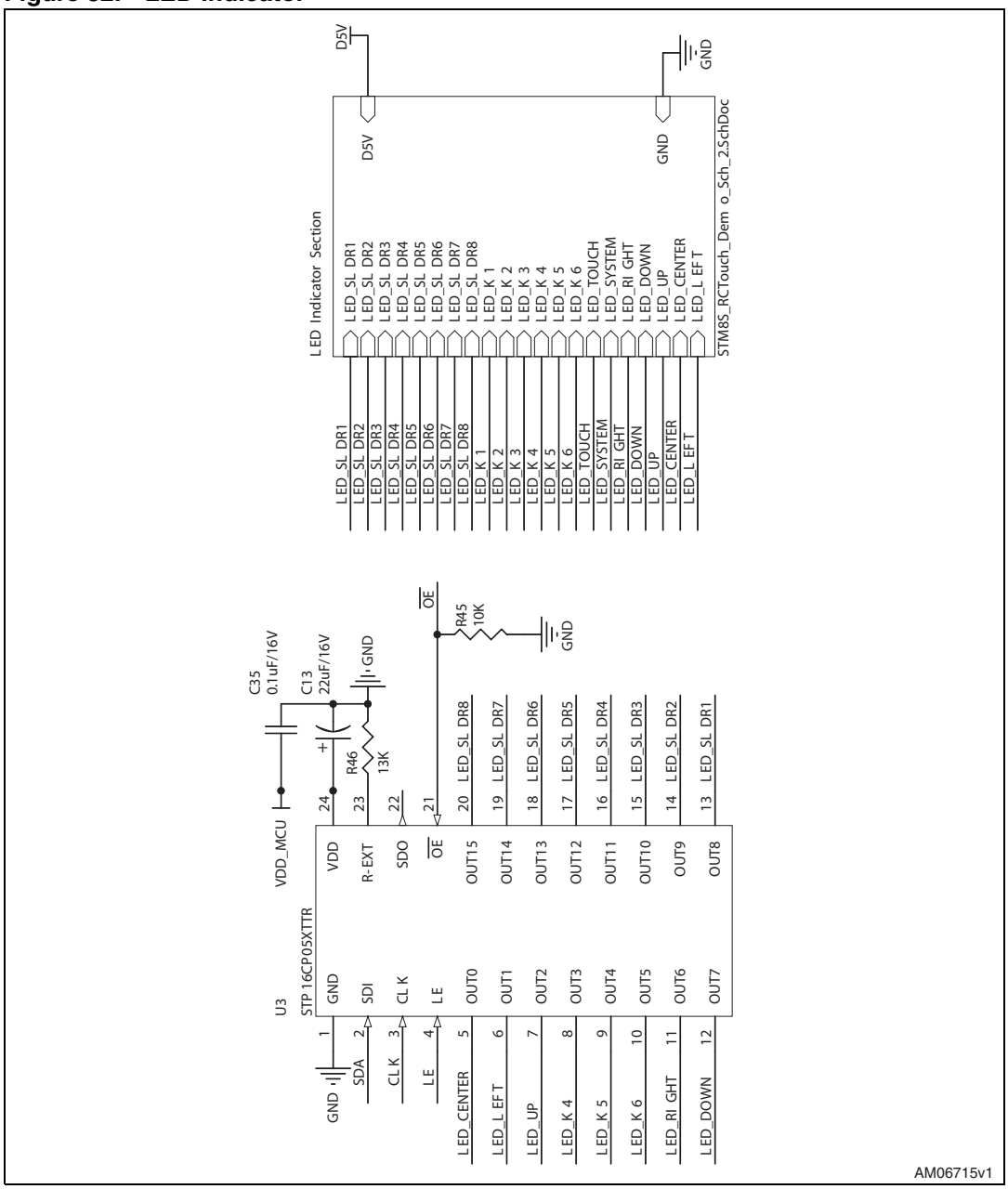


Figure 32. LED indicator



Revision history

Table 4. Document revision history

Date	Revision	Changes
16-Nov-2010	1	Initial release.
14-Dec-2010	2	Added: *Appendix B: Schematics*

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