QST family capacitive touch demonstrator kit

Overview

The QST family capacitive touch demonstrator kit is designed for the evaluation and development of applications based on QST family devices. The kit includes QST Demonstrator hardware, a USB cable and QST Demonstrator software. The QST Demonstrator hardware features a USB interface allowing connection to a computer for control and data viewing via the QST Demonstrator software.
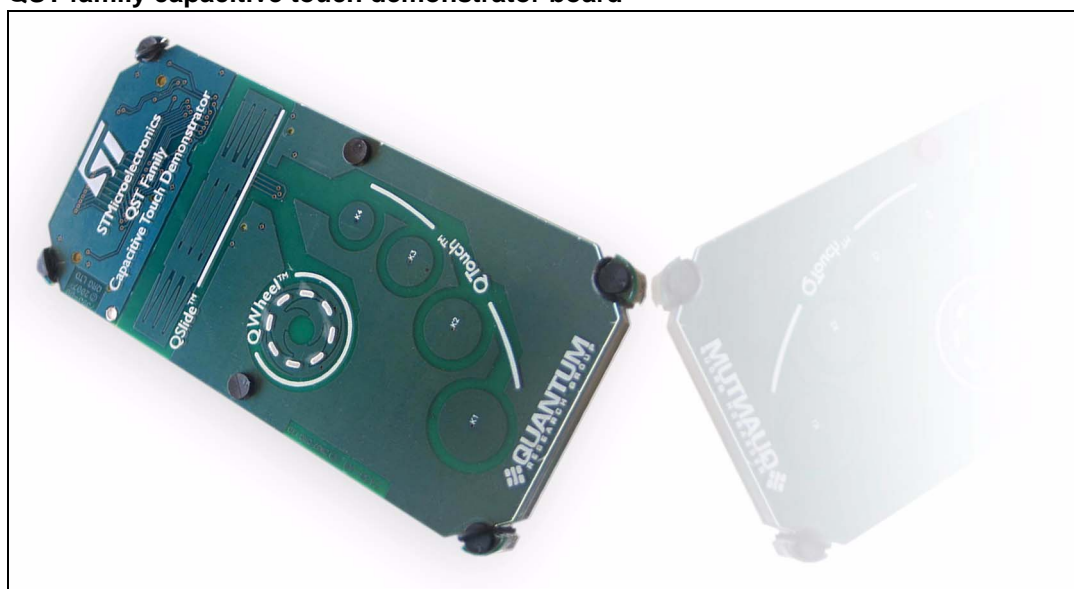
The QST device family is specifically designed for human interfaces, like control panels, appliances, gaming devices, lighting controls, remote controls, or anywhere a mechanical switch may be found.

The QST device family is based on the charge-transfer QProx™ technology from Quantum Research Group. Each device is a self-contained digital sensor IC capable of detecting near-proximity or touches on electrodes. It allows electrodes to project independent sense fields through any dielectric like glass, plastic, stone, ceramic, and wood. It can also turn metal-bearing objects into intrinsic sensors, making them responsive to proximity or touch. This capability coupled with its continuous self-calibration feature can lead to entirely new product concepts, adding high value to product designs.

Each of the channels operates independently of the others, and each can be tuned for a unique sensitivity level by simply changing its sample capacitor value.

Unique among capacitance sensors, the device incorporates spread-spectrum modulation for unsurpassed EMC compliance.

QST family capacitive touch demonstrator board

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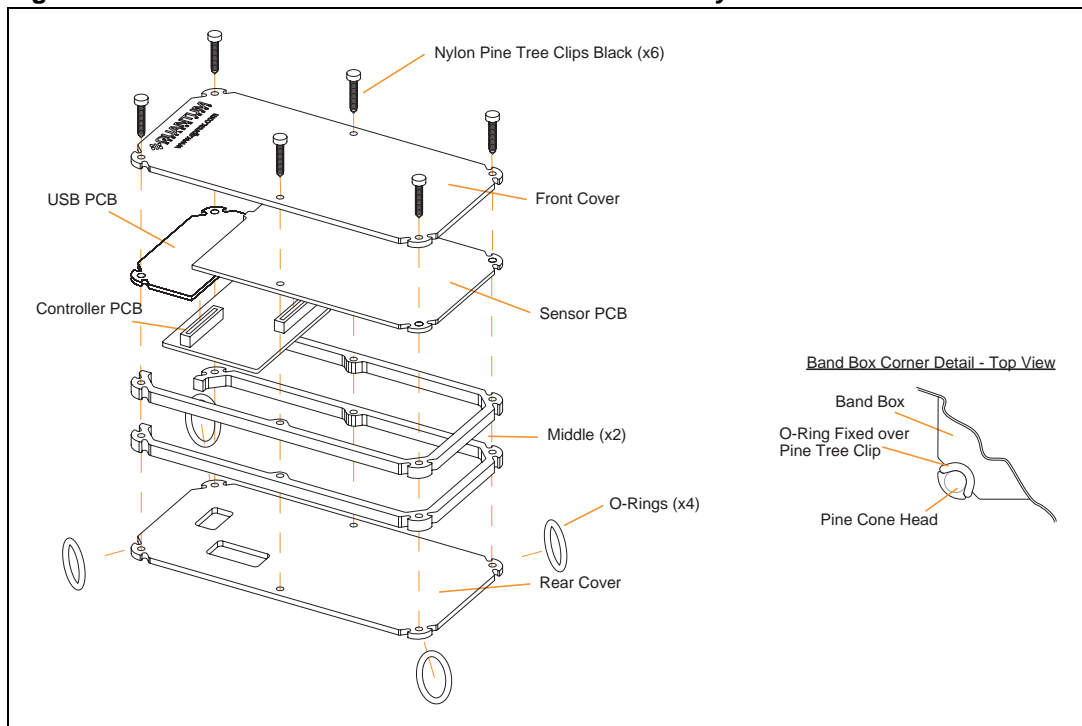
1 Setting up the demonstrator board

1.1 Contents of kit

● One QST Demonstrator unit composed of three boards (see *Figure 1*)

● One USB cable

● One mini CD-ROM containing information on the QST product family including QST Demonstrator software and the kit user manual

Figure 1. QST Demonstrator hardware board assembly

1.2 Setup instructions

To prepare the QST Family Capacitive Touch demonstrator for use, proceed as follows:

1. Using the USB cable provided, connect the QST Demonstrator hardware (*Figure 2*) to the computer. The LED (upper left corner) on the QST Demonstrator is lit constantly to indicate that there is power to the board.

2. Install the QST Demonstrator software; put the supplied CD in the CD drive of the computer. Copy the contents of the CD to the computer. Double click the QST Demo software to open it.

3. QST Demonstrator software is displayed on the computer monitor (*Figure 3*). The LED of the QST demonstrator hardware (upper right corner) now flickers continuously to indicate that QST Demonstrator software is communicating with the QST Demonstrator hardware.
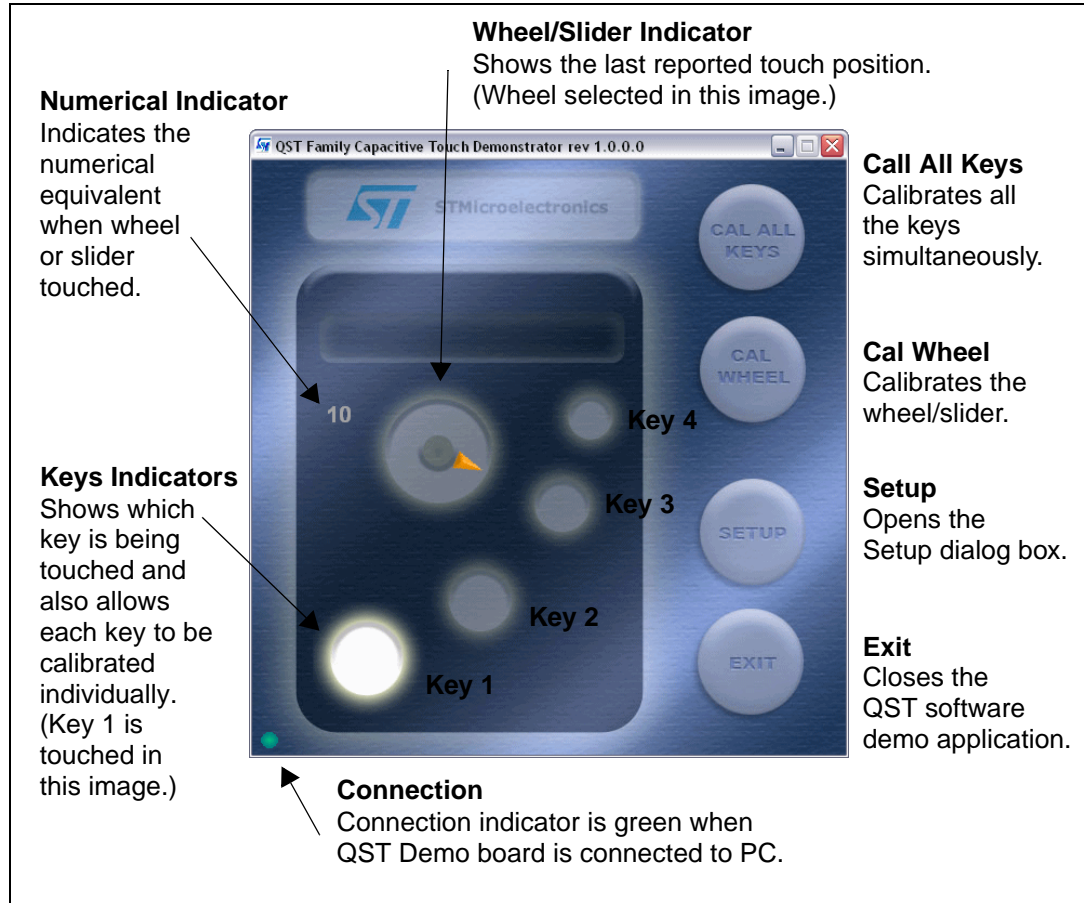
Figure 2. **QST Demonstrator control board**
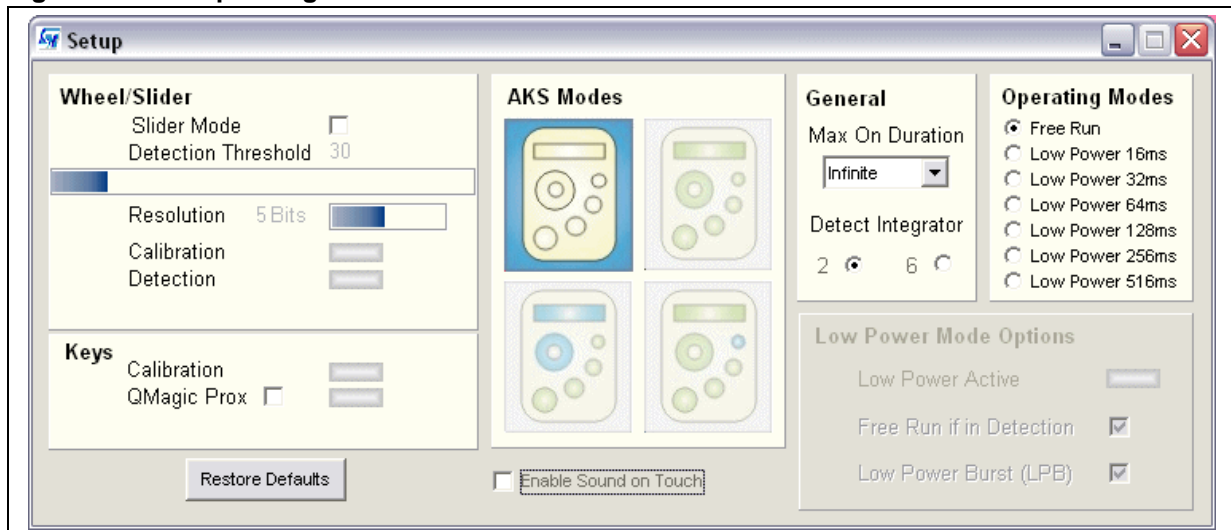
2 Getting started

The QST Family Capacitive Touch Demonstrator software is used with the QST Demonstrator hardware. With QST Demonstrator software you can send commands and see the effect of changing parameters.

Figure 3. Main window

Wheel/Slider Indicator
Shows the last reported touch position.
(Wheel selected in this image.)

Numerical Indicator
Indicates the numerical equivalent when wheel or slider touched.

Keys Indicators
Shows which key is being touched and also allows each key to be calibrated individually. (Key 1 is touched in this image.)

Call All Keys
Calibrates all the keys simultaneously.

Cal Wheel
Calibrates the wheel/slider.

Setup
Opens the Setup dialog box.

Exit
Closes the QST software demo application.

Connection
Connection indicator is green when QST Demo board is connected to PC.

2.1 Setup dialog box

Figure 4. Setup dialog box

2.1.1 Wheel/Slider Area

Slider Mode

The default setting for the software is the wheel. Select the Slider Mode check box to change the setting to the slider. The slider representation is highlighted in the main window.

Detection Threshold

This sets the amount of signal change which will cause the QST device to register wheel/slider touch detection. The values are from 0 to 255 (default is 30). Move the cursor over the Detection Threshold bar until the cursor turns into a double-headed arrow. Holding the left mouse button down, move the slider left or right to select a new threshold. The actual value is shown above the bar and changes in real time as the slider moves.

Calibration

This indicator lights to show when wheel/slider calibration is occurring. For more information, refer to *Section 2.2: Calibration on page 9*.
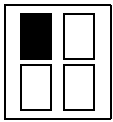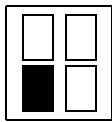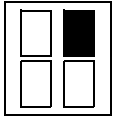
Detection

This indicator lights when a touch is detected on the wheel/slider.

Resolution

This sets the resolution of the wheel/slider (default value is 5 bits). Move the cursor over the Resolution bar until the cursor turns into a double-headed arrow. Holding the left mouse button down, move the slider left or right to select a new resolution. The number of bits is shown at the side of the bar and changes in real time as the slider moves.

Table 1. Wheel/Slider resolutions

Resolution	Number of Positions
2 Bits	4 positions (0 to 3)
3 Bits	8 positions (0 to 7)
4 Bits	16 positions (0 to 15)
5 Bits	32 positions (0 to 31) (Default)
6 Bits	64 positions (0 to 63)
7 Bits	128 positions (0 to 127)
8 Bits	256 positions (0 to 255)

2.1.2 Keys Area

Calibration

This indicator lights to show when key calibration is occurring. For more information, refer to *Section 2.2: Calibration on page 9*.

QMagic Prox
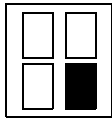
This function is not supported using the current QST demo hardware. To implement a QMagic proximity sensor, the hardware must be designed by increasing the size of the electrode and by using a higher capacitor value. The user may evaluate this function by designing a specific sensor board and enabling the feature using the GUI.

2.1.3 AKS Modes Area

The patented Adjacent Key Suppression (AKS™) Modes feature works to prevent multiple keys from responding to a single touch. It suppresses touches from weaker responding keys and only allows detection of the dominant key (or group of keys).

Click an AKS Modes icon to select a new AKS mode as described in *Table 2*.

Table 2. AKS mode selection icons

Icon	Description	Icon	Description
Upper left	AKS disabled (no AKS) (Default)	Lower left	AKS Keys + Wheel
Upper right	AKS global (all keys AKS'd together)	Lower right	AKS 1 Key + (3 Keys + Wheel)

2.1.4 General Area

Max On Duration

The device can time out and recalibrate each key independently after a continuous touch detection that lasts for the selected 'Maximum On Duration' (MOD). This ensures that a key can never become 'stuck on' due to foreign objects or other external influences. After recalibration, the key will continue to function normally.

The nominal delay is selectable from 10s, 20s, 60s, or infinite (default), though the actual delay may vary in certain operating modes (see *Table 3*).

Table 3.   Max On Duration

Operating Mode	Max on-durations
Free Run	10s, 20s, 60s
LP mode, 16ms sleep time	10s, 20s, 60s
LP mode, 32ms sleep time	10s, 20s, 60s
LP mode, 64ms sleep time	10s, 20s, 60s
LP mode, 128ms sleep time	11s, 22s, 65s
LP mode 256ms sleep time	12s, 24s, 70s
LP mode 516ms sleep time	21s, 46s, 138s

Detect Integrator

The Detect Integrator (DI) filter confirmation function reduces the effects of noise on key states. The DI mechanism requires a specified number of measurements that qualify as detections (and these must occur in a row) or the detection will not be reported. In a similar manner, the end of a touch (loss of signal) also has to be confirmed over several measurements.

Select the appropriate check box to select two or six DI measurements for confirming start of touch; end of touch always uses two measurements.

2.1.5 Operating Modes Area

Select one of the Operating Modes options. If a Low Power mode is selected, the corresponding options in the Low Power area become available. Unavailable options appear dimmed.

The available operating modes are:

● Free Run - fastest detection response at all times
● LP mode - low power, slower touch sensing response

Free Run Mode

This mode uses a continuous stream of acquire bursts. Free Run mode has, in consequence, the highest power drain of all the QST Demo operating modes but the fastest response time.

Low Power (LP) Mode

In LP mode, the QST Demo spends most of the time sleeping to conserve power; it wakes itself periodically to perform acquire burst s, then normally goes back to sleep again.

The QST Demo provides a choice of intervals between acquire bursts to allow an appropriate speed /power trade-off to be made for each product.

Low Power

This indicator is lit when the QST device is in a Low Power mode. Although a Low Power mode may be selected in the Operating Modes area, when a key or the wheel/slider is touched the indicator goes out. This is because for the period of detection/touch the mode automatically changes to Free Run and then back to the original mode when detection/touch is finished.

Free Run if in Detection

Select the Free Run if in Detection check box to automatically change the mode to Free Run whenever a touch is selected. This makes the response quicker, otherwise the device goes back to sleep for the allotted time between measurements.

Low Power Burst (LPB)

Select the LPB check box to initiate a burst after each I²C transfer; clear the check box to stop the LP bursts.

2.1.6 Other Options

Restore Defaults

Click this button to restore the default settings.

Enable Sound on Touch

Select this check box to enable a sound to be heard when a key or the wheel/slider is touched. Clear this check box to disable the sound.

2.2 Calibration

To calibrate the keys, wheel or slider, set the **Max On Duration** to 10 seconds, for example, and then leave your finger on a key. After 10 seconds, the key will recalibrate, causing the indicator to switch on momentarily.

Clicking on the individual key, Cal All Keys or Cal Wheel buttons using the software interface will recalibrate the corresponding element at the next firmware cycle.

3 Advanced evaluation

It is possible to use the QST demo board to go beyond a standard and simple evaluation of the device. If you wish, you may evaluate various electrode shapes and sizes by designing your own sensor board or you can play with the front panel thickness and/or materials.

This section provides help tips and recommendations.

3.1 Working with a different front panel thickness and/or material

The panel thickness and its material type ('dielectric constant') play a large part in determining the strength of electric field at the surface of the control panel. If the metal electrodes are on the inside surface of the substrate, then the thickness and material of the substrate are also factors.

Glass has a dielectric constant range from 7.6 to 8.0 compared with plastics which range from 2 to 3. Higher numbers means the fields will propagate through more effectively. A 5mm panel with a dielectric constant of 8 will perform similarly in sensitivity to a 2.5mm panel with a dielectric constant of 4, all other factors being equal.

Up to 10mm of plastic panel is quite usable, depending on the key spacing and size. During development, the circuit sensitivity needs to be adjusted to compensate for panel thickness, material used, and electrode size. As a rule, the electrode shape should have a minimum dimension of at least 4 times the panel thickness for reliable operation.

When modifying panel thickness and its dielectric constant, it is important to take into consideration certain capacitor values. The thicker the panel, the higher the capacitor value required. Note that increasing the sampling capacitor also slows the response time of the key.

Table 4 lists which capacitors to modify in relation to their corresponding electrodes.

Table 4.   Capacitor table

Electrodes	Controller Board Capacitor Reference [1]
Slider/wheel	C5, C7 and C8
Key 1	C1
Key 2	C2
Key 3	C3
Key4	C4

1.   See *Figure 6: Control board schematic*.

Once the design is transferred to production, the panel composition and thickness should not be changed without re-testing.

3.2 Make your own board

Due to its modular design, you can easily develop your own sensor board. By connecting it to the controller board (connector J5B), you can evaluate the performance of various types of electrodes and specific assemblies. For more information, refer to Application Note *AN2547: Recommendations for designing a capacitive touch sensor board*.

Appendix A   Schematic diagram
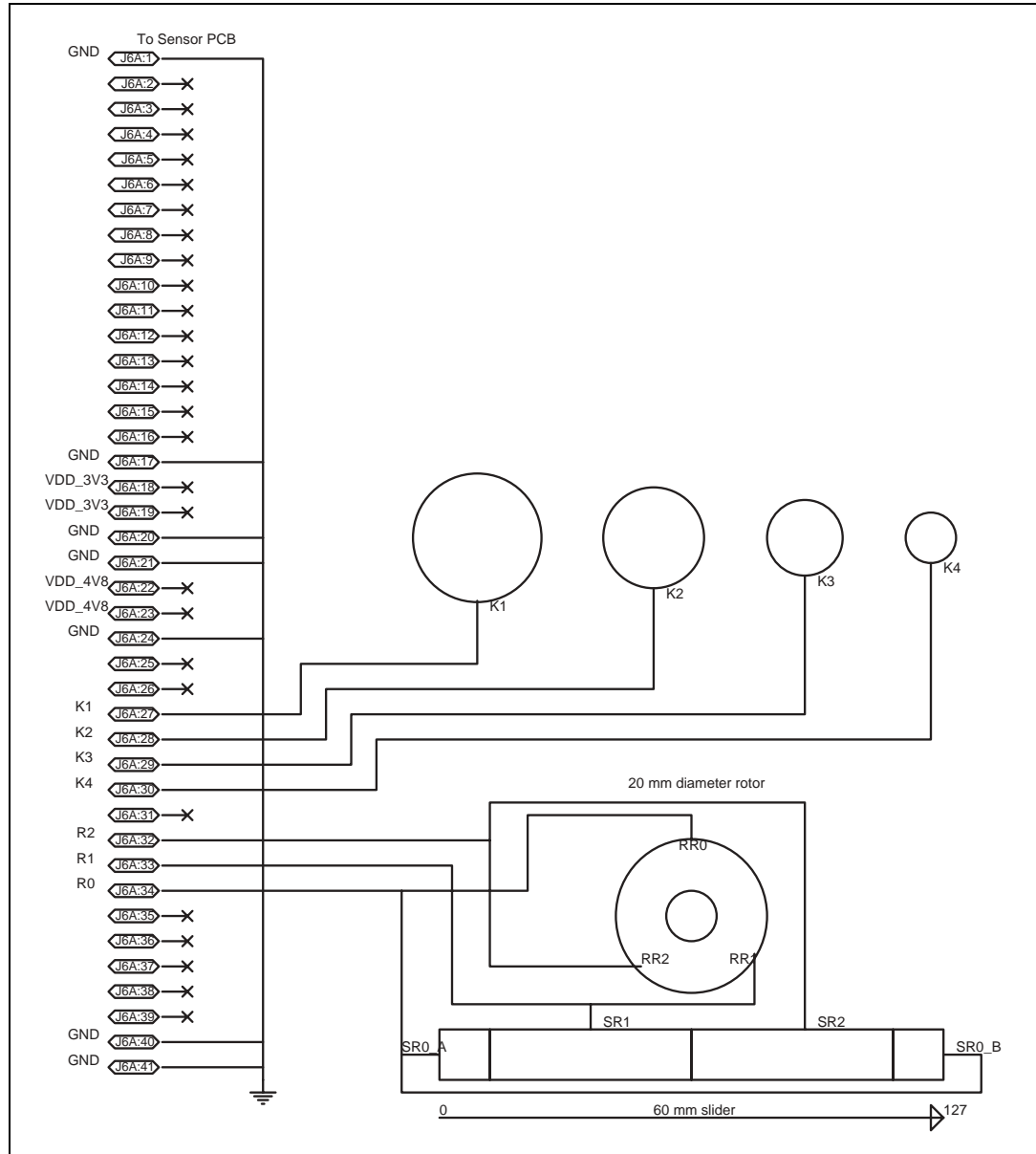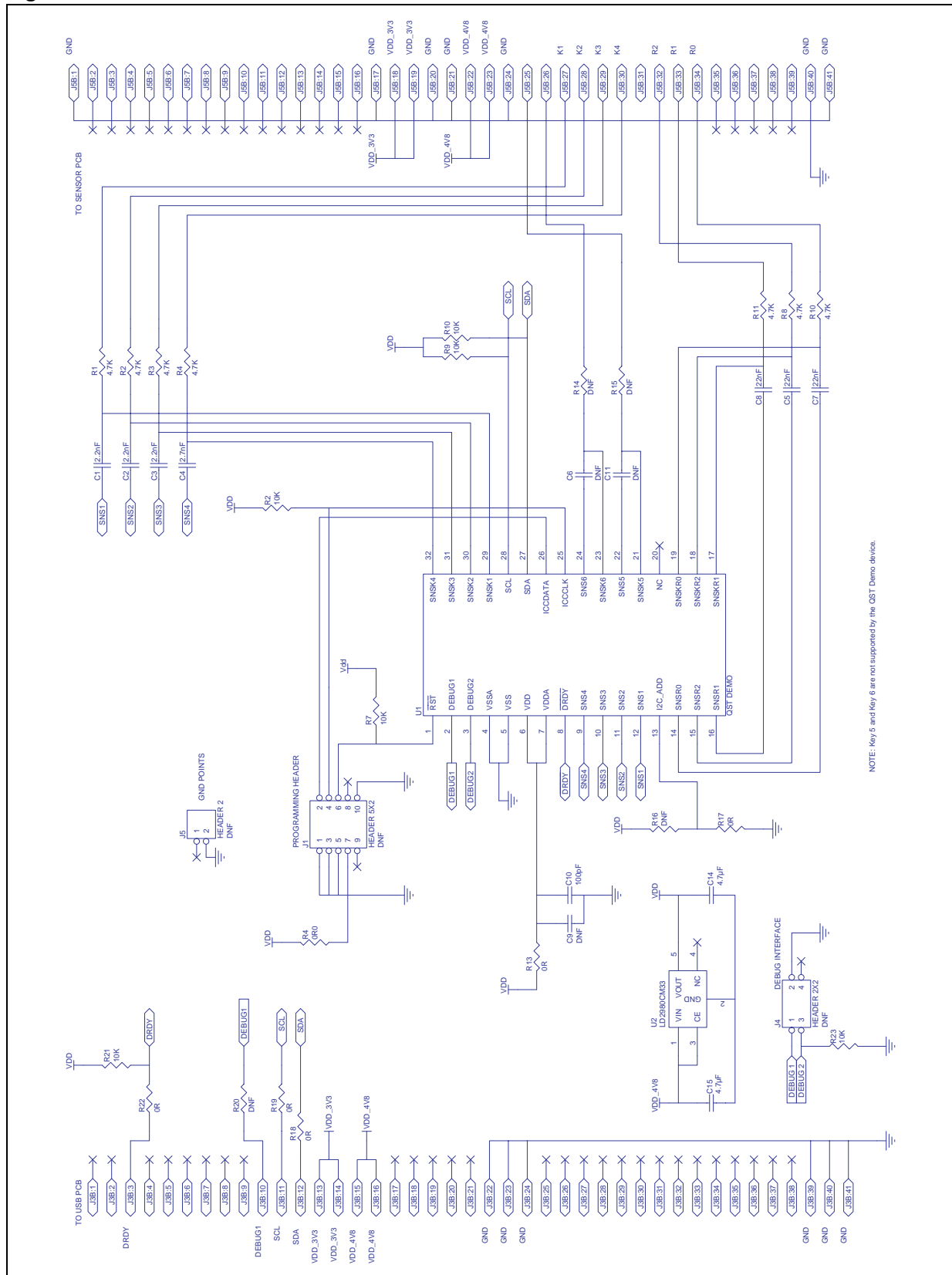
Figure 5.   Sensor board schematic

Figure 6. Control board schematic

Revision history

Table 5.   Document revision history

Date	Revision	Changes
1-June-2007	1	Initial release.

Please Read Carefully: