UM10505

OM11057 quick start guide

Rev. 2 — 10 April 2013 **User manual**

Document information

Info	Content
Keywords	Capacitive switch, sensor, proximity switch, OM11057, PCF8885, PCA8885, PCA8886, evaluation board
Abstract	The OM11057 is an evaluation board which can be used to demonstrate and evaluate the PCA8886 and PCF8885 capacitive touch and proximity sensors. The board can be powered by using a Mini USB cable or battery.

Revision history

Rev	Date	Description
v.2	20130410	revised user manual
v.1	20120402	new user manual, first revision

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1. Introduction

The purpose of this board is to demonstrate the capabilities of NXP's 8-channel touch sensor PCF8885 to implement buttons, switch wheels and sliders as well as proximity sensing with the dual channel PCA8886.

Features:

- Demonstration of the dual channel proximity sensor to wake up the board, one channel reserved for external sensor pad
- Demonstration of an interface with 4 buttons, a switch wheel and a slider by using an 8-channel sensor circuit in multiplexed mode
- Enables touch sensitivity through 3 mm acrylic overlay plate
- Works stand alone
- Can be powered either with 2 AA-batteries or via USB
- Feedback with a piezoelectric sounder
- Feedback with RGB diodes
- Software can be modified using LPC-link
- Low-cost Cortex-M0 LPC1114 controller board with 32 kB Flash Memory
- PCF8885, 8-channel capacitive sensor
- PCA8886, 2-channel proximity sensor. One channel reserved for external sensor
- PCF8536 LCD/LED driver

Remark:

The physical properties of any touch experiment are determined by different factors.

These factors are:

- Size of touching entity (single finger, several fingers, palm … hand)
- Speed of approaching object
- Environmental properties like humidity, contamination

By default, the board is configured to:

- Accept a 'typical human touch', **too fast and too slow movements are screened out**, No fly or turtle will be detected
- **As a push-button. If you just touch it slightly, as it would be hot, the capacitance formed by the finger and the sensor area will be to small (just a few mm^2) and will not be recognized as a touch**

The demo board should be put on a desk and not touched on the bottom side as this would short circuit the sensor inputs and cause false switching!

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2. Quick start

- The demo board is powered up with the power switch
- When the power is turned on, a start-up animation will be shown and the board will be set in RGB (Red-Green-Blue) mode. This enables the user to obtain a mixture of red, green and blue with varying intensity of each color.
- A touch on the color selection buttons should be centered on the graphical icon
- The sampling frequency is optimized for a human touch, which means that very quick or slow touches will be ignored
- For switching between RGB, RED, GREEN and BLUE mode, press the appropriate button (the display will show RGB channels, RED channel, …)
- In RGB mode, the control is similar to the living color lamp from Philips. By using the switch wheel, the LCD backlight will sweep through the entire light spectrum, and the slider will do the same for the control panel lighting. In RGB mode, there is no end and no beginning, so the wheel can be turned indefinitely in both directions (same principle for the slider). After a certain time, you will end up at the same color of course.
- When navigating in the RGB mode, if one of the colors RED, GREEN or BLUE is chosen, the scroll wheel and the slider will only affect the intensity of the color chosen in the mixture.
- If the board is not touched for 20 seconds, it will switch to sleep mode. The LEDs and the LCDs are switched off and a little red LED is switched on to indicate that the board is in sleep mode. In order to wake up the board, approach the board with your hand. The status of the board will be the same as before sleep mode

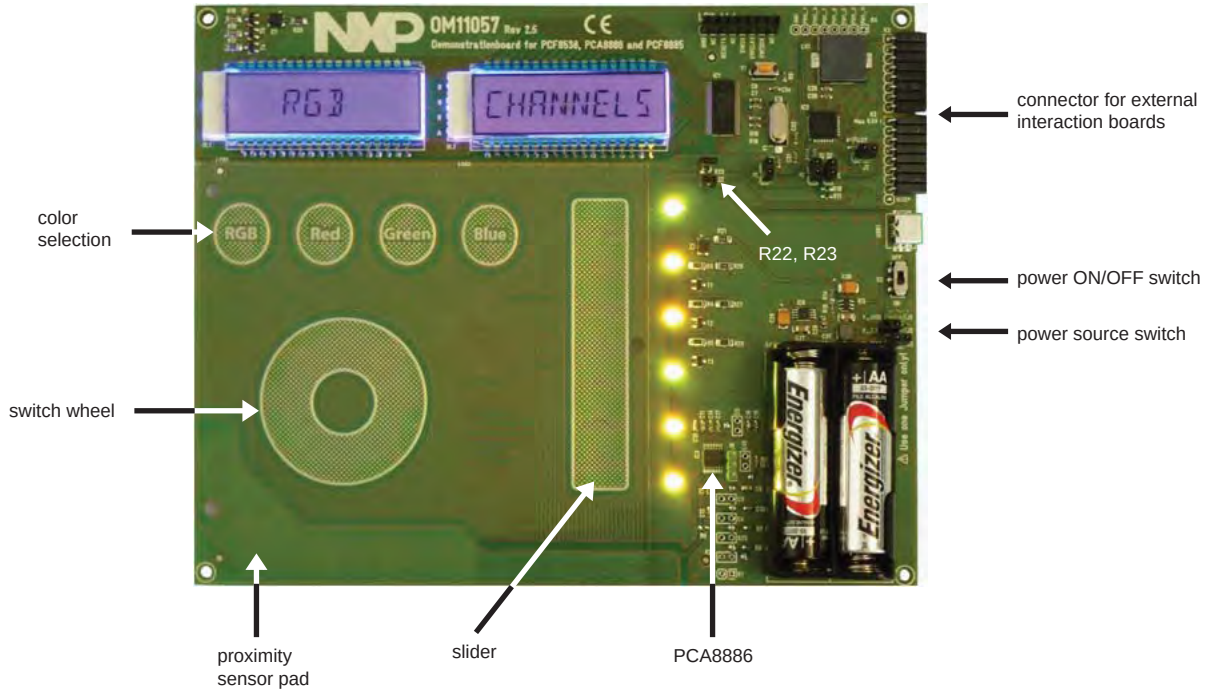


Fig 1. OM11057, top view

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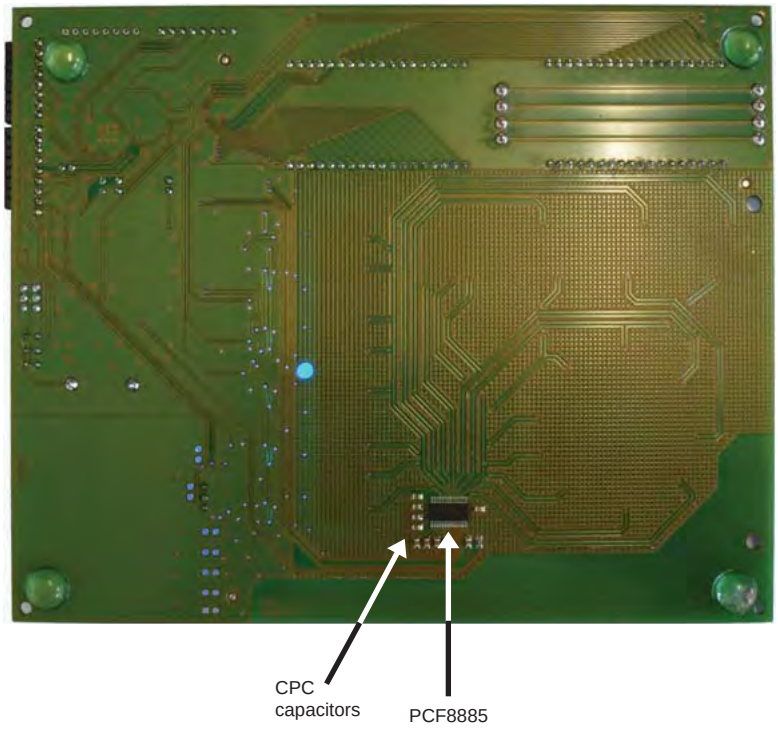


Fig 2. OM11057, bottom view

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3. Board details

3.1 Power options and ON/OFF switch

Figure 1 shows the ON/OFF and power source selection switches. 2 AA batteries, a USB cable or an external power supply can be used. By default, batteries are used.

3.2 PCF8885

The color selection buttons, the switch wheel, and the slider are connected to the PCF8885.

3.2.1 Sensitivity and approach speed

The sensitivity of the sensor channels of the PCF8885 is approximately a linear function of the value of the reservoir capacitors named CPC0 to CPC7, shown in Figure 2.

The specified maximum value for this component is 470 nF and the board is assembled with this value to allow 3 mm thick acrylic overlay with margin in sensitivity.

The approach speed sensitivity is a parameter that describes the speed of an approaching object to be detected. This board is optimized for a “human touch” and filters out everything slower or faster. The approach speed sensitivity is directly set by the sampling frequency. Reducing the value of the CPC capacitors makes the range of this speed smaller as the sensitivity would be lower.

The nominal oscillator frequency is 70 kHz, the sampling frequency of the board is 1.914 kHz resulting in a switching time of 33 milliseconds. This time starts when a finger enters the coverage distance of the sensor pad and as soon as 64 consecutive samples are counted the output of the sensor is switched. Hence there is no additional time for post processing of the samples.

3.2.2 Color selection buttons

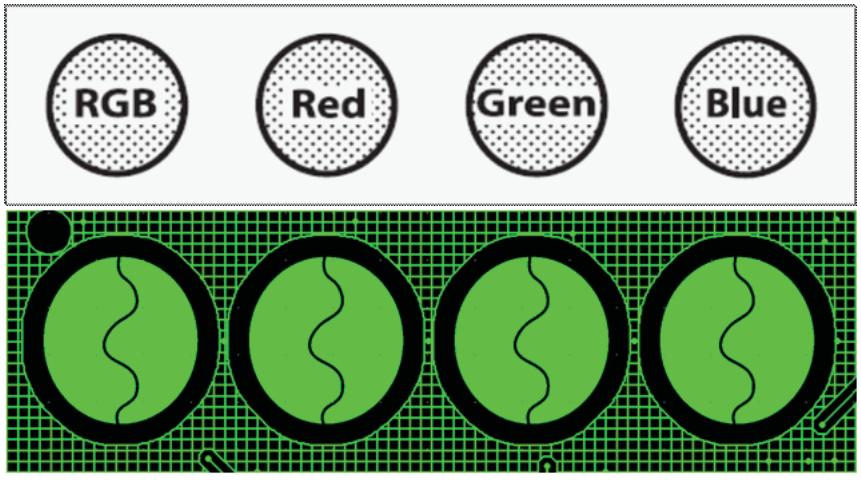


Fig 3. Color selection buttons with pairs of interleaved sensor pads

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As shown in Figure 3, the buttons for color selection are made of two interleaved sensor pads connected to two separate sensor channels. In order to make sure that both channels are activated, the touch should be centered on the graphical icon engraved on the acrylic overlay.

3.2.3 Switch wheel

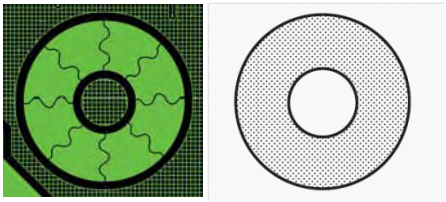


Fig 4. Switch wheel

The switch wheel is implemented as eight interleaved pairs of sensor pads connected to eight sensor channels. The touch will be recognized when moving from one to next segment.

3.2.4 Slider

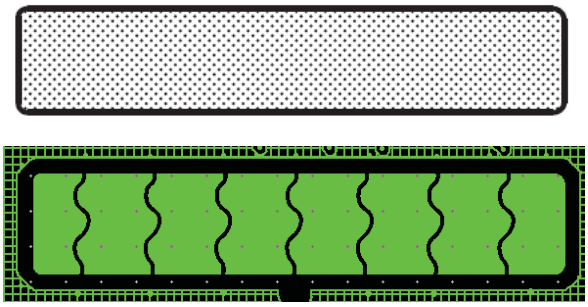


Fig 5. Slider

The slider is implemented as seven interleaved pairs of sensor pads connected to eight sensor channels. The touch will be recognized when moving from one to next segment.

3.3 PCA8886 proximity sensor

The proximity sensor pad is connected to the PCA8886.

3.3.1 Sensitivity and approach speed

The sensitivity for the proximity sensor is set by the CPC capacitor connected to the PCA8886 as shown in Figure 6. The specified maximum value for this component is 2.5 µF and the board is assembled with this value.

The approach speed sensitivity for proximity sensing is a result of the sampling frequency and set with the capacitor CLIN which has 47 pF on the board to set a sampling rate of 640 Hz and a switching time of 100 ms.

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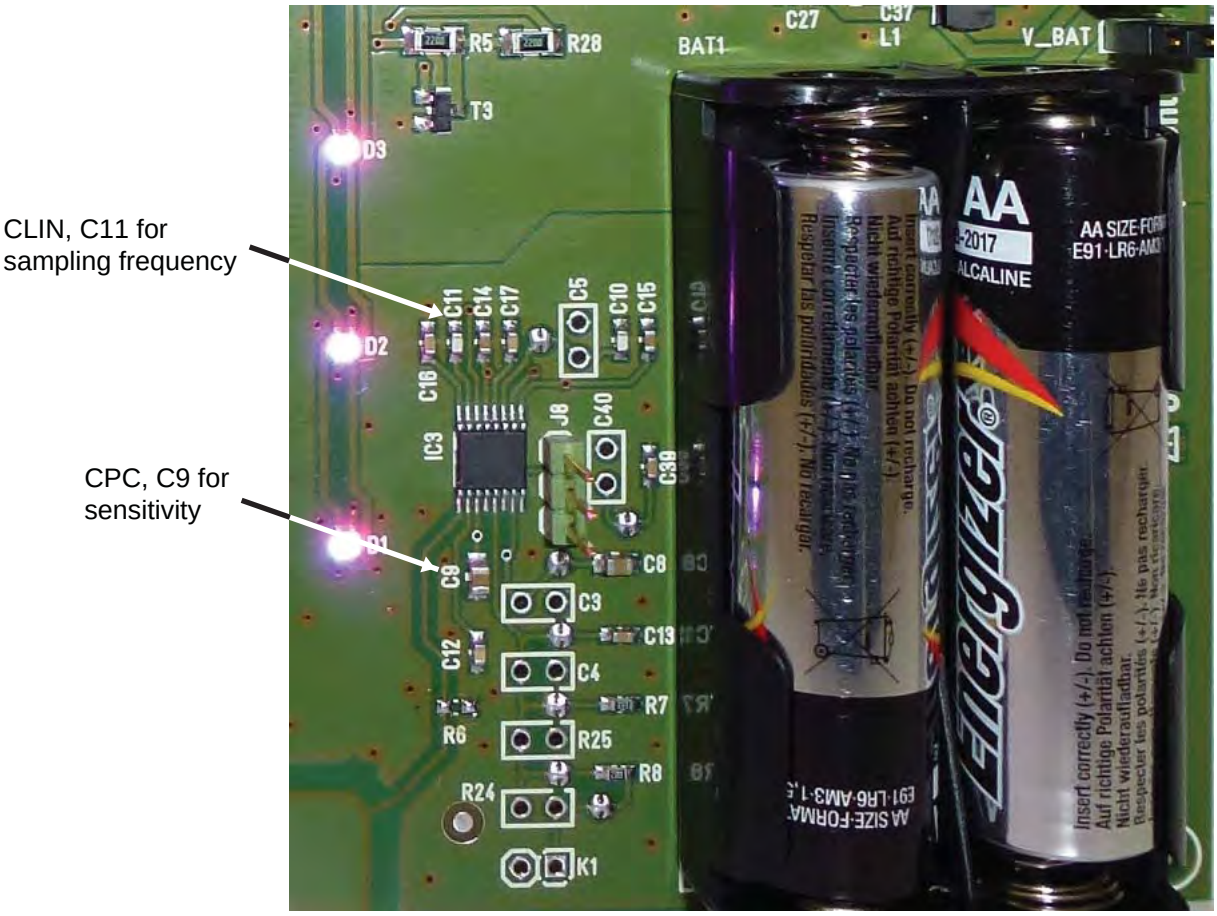


Fig 6. Capacitors for sensitivity and sampling frequency

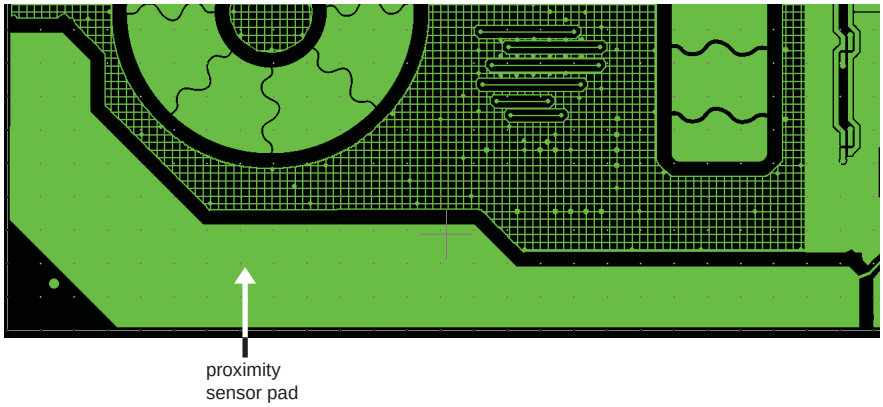


Fig 7. Proximity sensor pad

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4. Add-on boards

Two add-and boards are currently available for the OM11057:

OM11057A: This is a board designed to demonstrate high sensitivity allowing thick overlays (5 mm).

OM11057B: This is a board designed to demonstrate usage of multiplexing on a flex print board.

4.1 OM11057A

Key features:

- Two PCF8885 packages: One driving buttons, the other driving a slider
- Through holes in the buttons for backlight
- PCA9535PW (a GPIO expander) drives the 16 LEDs mounted on the reverse side of the board
- Supplied from the OM11057 main board through K2 or with external power through K3
- This board is also prepared to be connected to an external I^2C master through K3

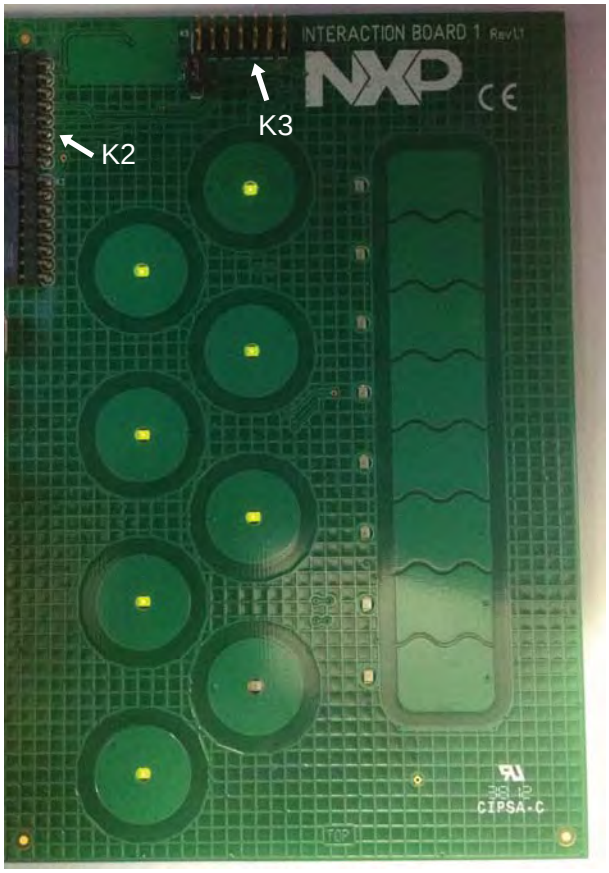


Fig 8. OM11057A

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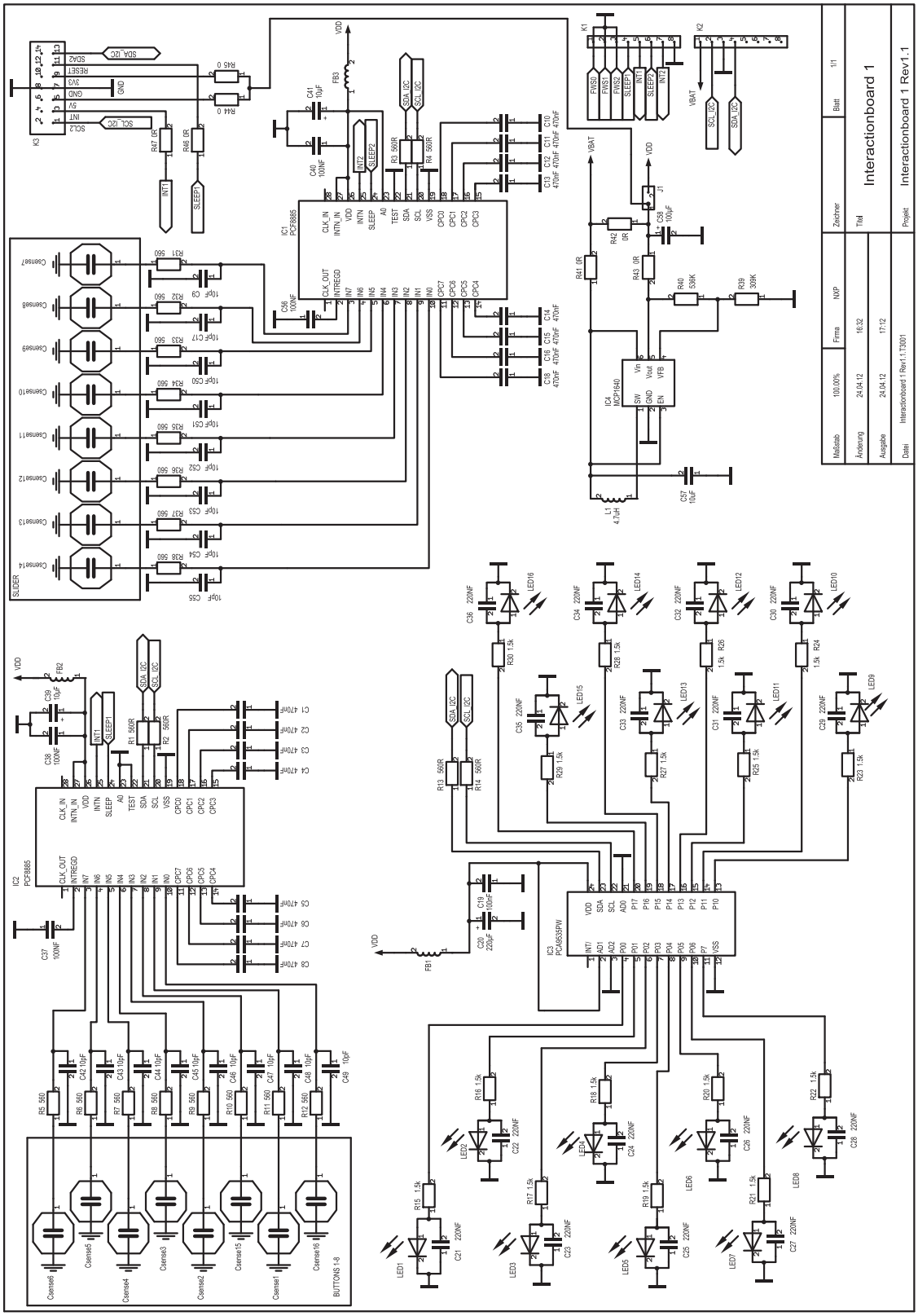


Fig 9. OM11057A circuit diagram

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4.1.1 Operation with OM11057A

The PCF8885 IC on the main board has to be disconnected from the I²C bus by removing the jumpers on the R22 and R23 positions. J2 and J3 shall be inserted to use the batteries to supply the add-on board.

The operation is simple: A touch on the buttons is indicated with the LED being switched on. At the same time the choice will be displayed on the display on the main board. Moving a finger on the slider will turn on the LED corresponding to the pair of channels activated at the moment and as soon as the finger moves away, the LED will switch off.

4.1.2 Operation via external I²C master

The add-on board can also be operated through the I²C connector K3 (see Figure 8 and Figure 10). 3.3 V or 5 V may be used for supply. In this case only the INT and SLEEP pins of IC1 are wired to the connector and IC2 through the I²C bus.

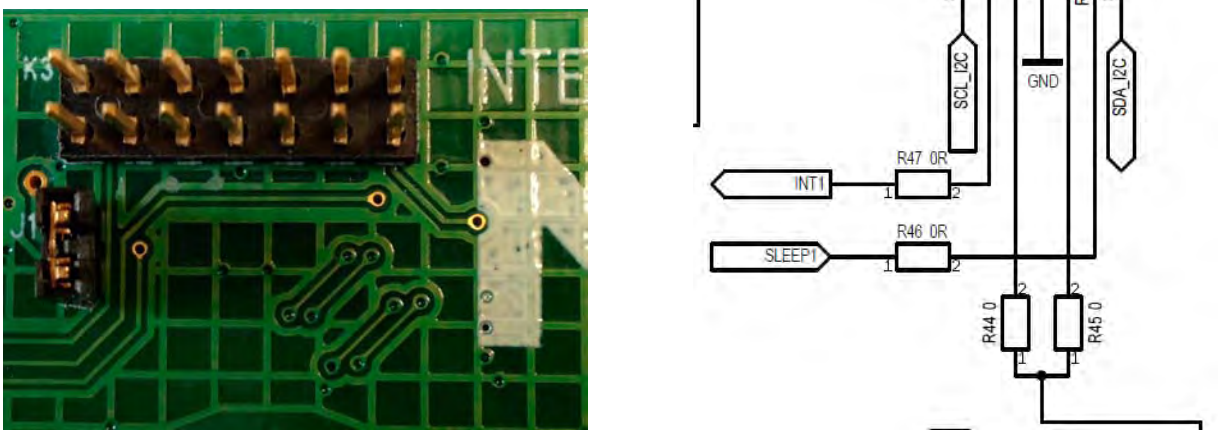


Fig 10. OM11057A I²C connector

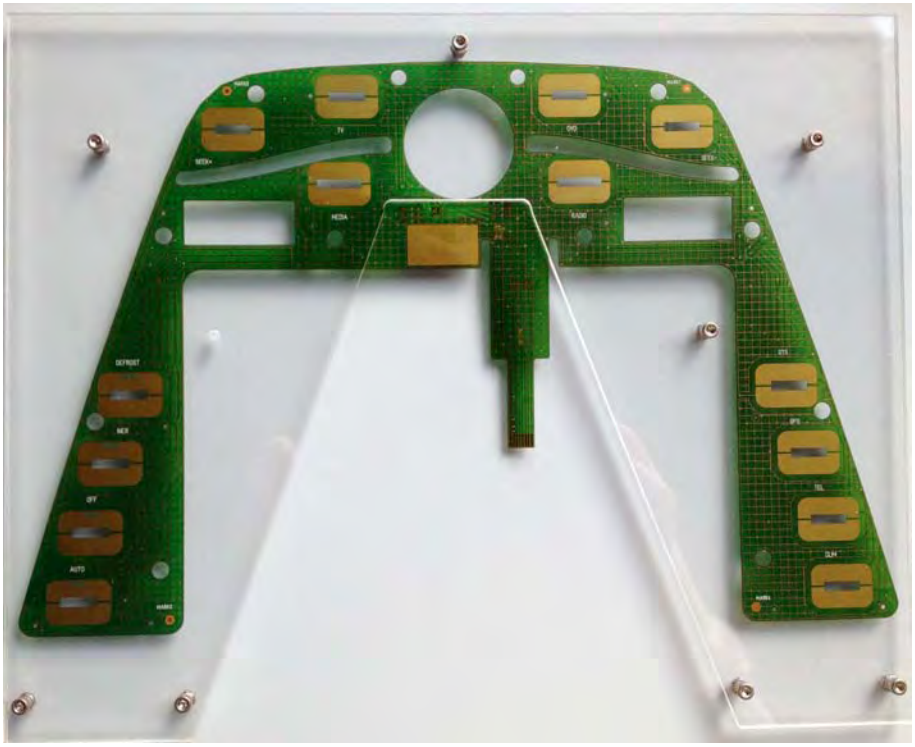
4.2 OM11057B

Key features:

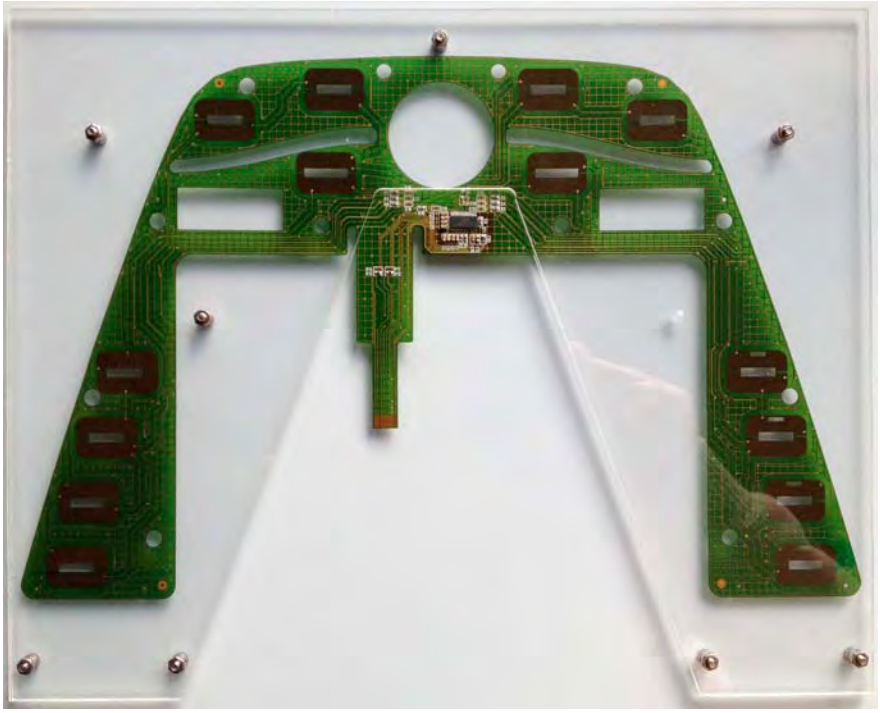
- This flex print board has been designed to demonstrate implementation of 14 touch buttons by multiplexing the 8 channels of the automotive PCA8885
- PCA8885 is configured in 2-key mode such that two sensor pads creating a button have to be touched in order to report a capacitive event
- Dimension of the board: 190 mm × 296 mm
- There is an opening for backlighting LEDs in the middle of the buttons

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a. Top view



b. Bottom view

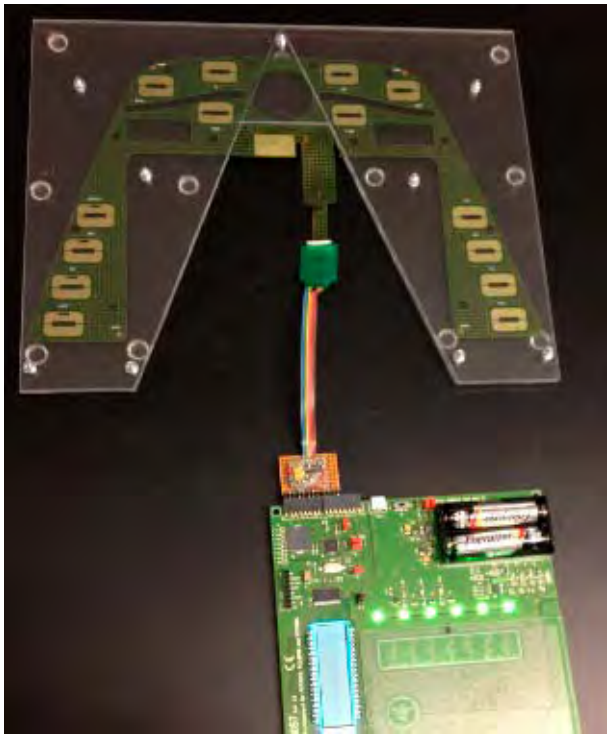
Fig 11. OM11057B

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4.2.1 Operation with OM11057B

This flex print can be supplied and operated with OM11057 as shown below. A touch on one of 14 buttons is indicated by displaying the corresponding function name on the display of OM11057 and a click sound with a piezzo electric buzzer will be generated as well.



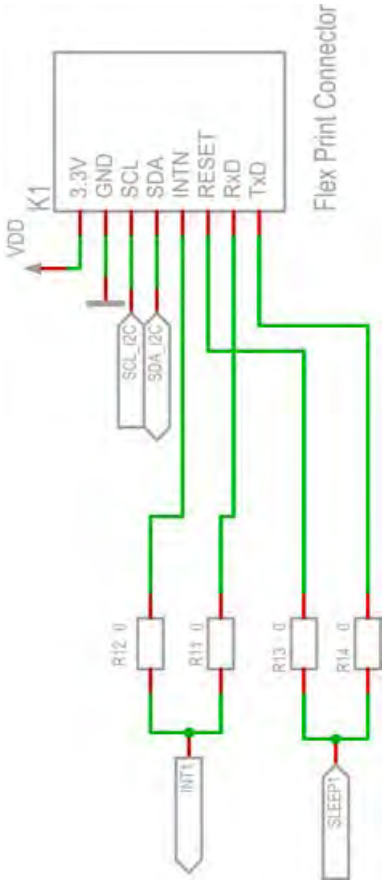


Fig 12. OM11057B flex connector

4.2.2 Operation via external I²C master

This add-on board can also be operated by an I²C master. Either 3.3 V or 5 V can be used as supply. The $\overline{\text{INT}}$ and SLEEP pins are wired to optional pins of the connector through R11, R12, R13, and R14.

If the SLEEP pin is not used, it has to be wired to GND or decoupled with several hundred nF capacitance. Otherwise, this pin will catch up disturbances such that the sensor IC fails.

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5. References

[1] **PCA8886 —** Dual channel capacitive proximity switch with auto-calibration and large voltage operating range, Data Sheet

[2] **PCF8885 —** Capacitive 8-channel proximity switch with auto-calibration and very low-power consumption, Data Sheet

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