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User manual for the TFT touch demo board OM11058

Rev. 1 — 25 June 2013   **User manual**

Revision history

Rev	Date	Description
v.1	20130625	new user manual, first revision

Contact information

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1. Introduction

Fig 1.   OM11058 demo board

Interactive user interfaces like in smartphones have become a must also in automotive, industrial and white goods control units.

Unlike smartphones where multi-touch, drag and drop and zooming features are used, the dedicated user interfaces in, for instance climate control or washing machine, only have to be a replacement of mechanical buttons by on-display touch buttons. Accordingly, the hardware- and software-design should be as simple as possible.

The PCA8885 and PCF8885 are providing very suitable features for easy configuration, connection of various numbers of channels, optimization of sensitivity and sampling for each application.

The purpose of the OM11058 is to demonstrate the capabilities of the PCA8885 and PCF8885 for touch displays.

1.1 The PCA8885 and PCF8885 multi-channel capacitive proximity sensors

The PCA8885 and PCF8885 are capacitive 8-channel touch and proximity sensors detecting changes in capacitance on remote sensing plates. Changes in the static capacitances (as opposed to dynamic capacitance changes) are automatically

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compensated using continuous auto-calibration. Remote sensing plates (for example, conductive foils) can be connected to the IC. The eight input channels operate independently of each other. There is also a built-in option for a matrix arrangement of the sensors: interrupts are generated only when two channels are activated simultaneously, suppression of additional channel outputs when two channels are already active.
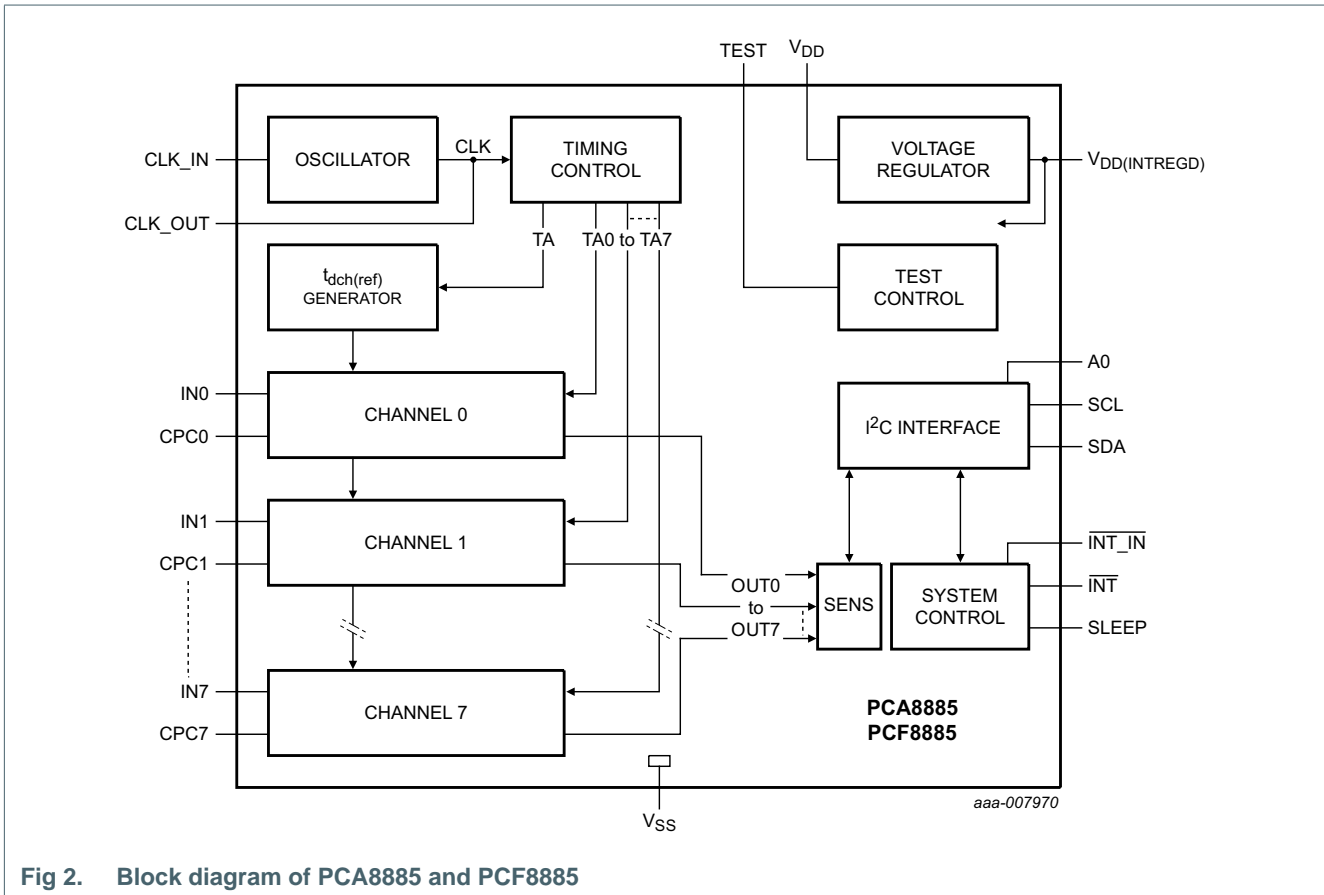

Fig 2.   Block diagram of PCA8885 and PCF8885

Key features of the PCA8885 and PCF8885 are:

- Eight independent channels (can be configured as 4×4 matrix)
- I^{2}C-bus interface
- One subaddress to enable up to 64 keys, cascading 2 devices
- Sleep mode, activated via I^{2}C-bus or external input
- Three sensing modes: one key, two keys and n-keys
- Two event handling modes: direct and latching mode
- Adjustable scan frequency
- Channel masking feature
- Fast start-up mode
- Operating temperature range ($T_{amb} = -40\ ^\circ C$ to $+85\ ^\circ C$)
- TSSOP28 and SO28 package available
- PCA8885: AEC-Q100 compliant for automotive and harsh environment applications

2. Description and technology of OM11058
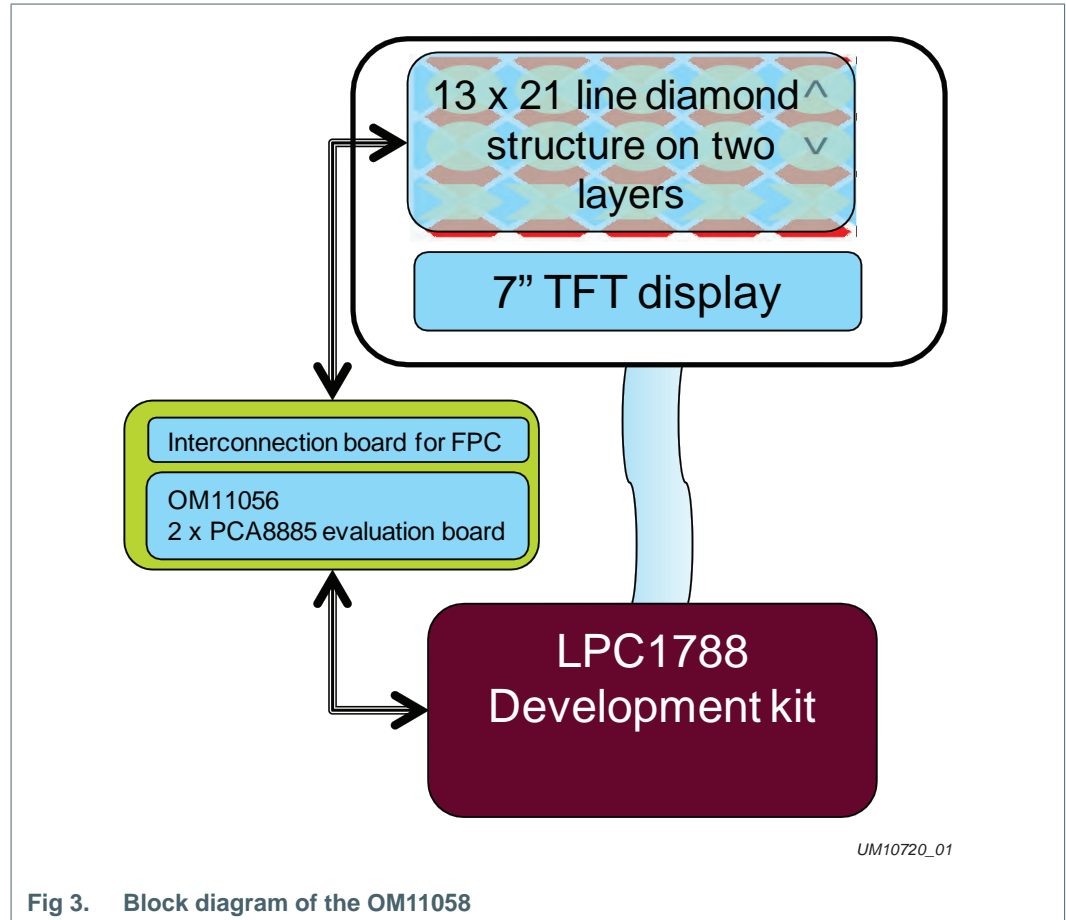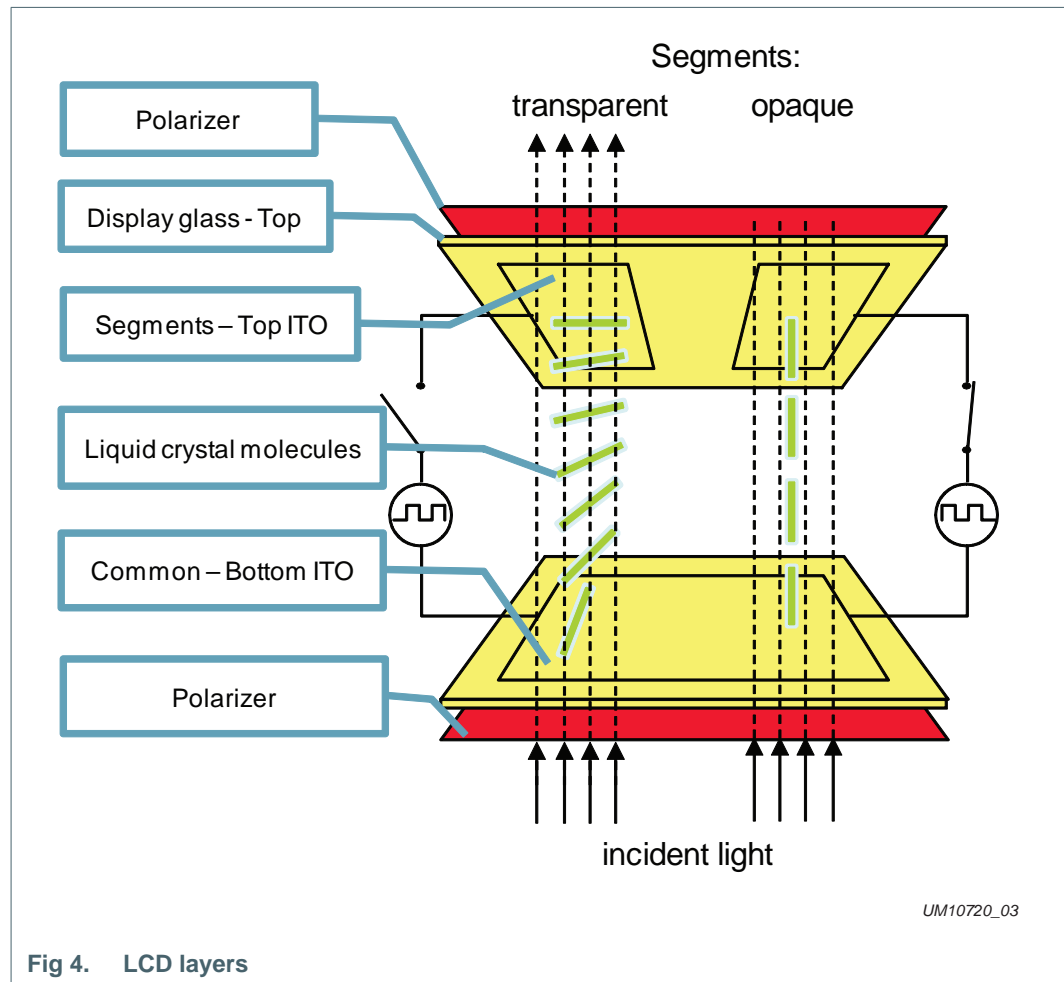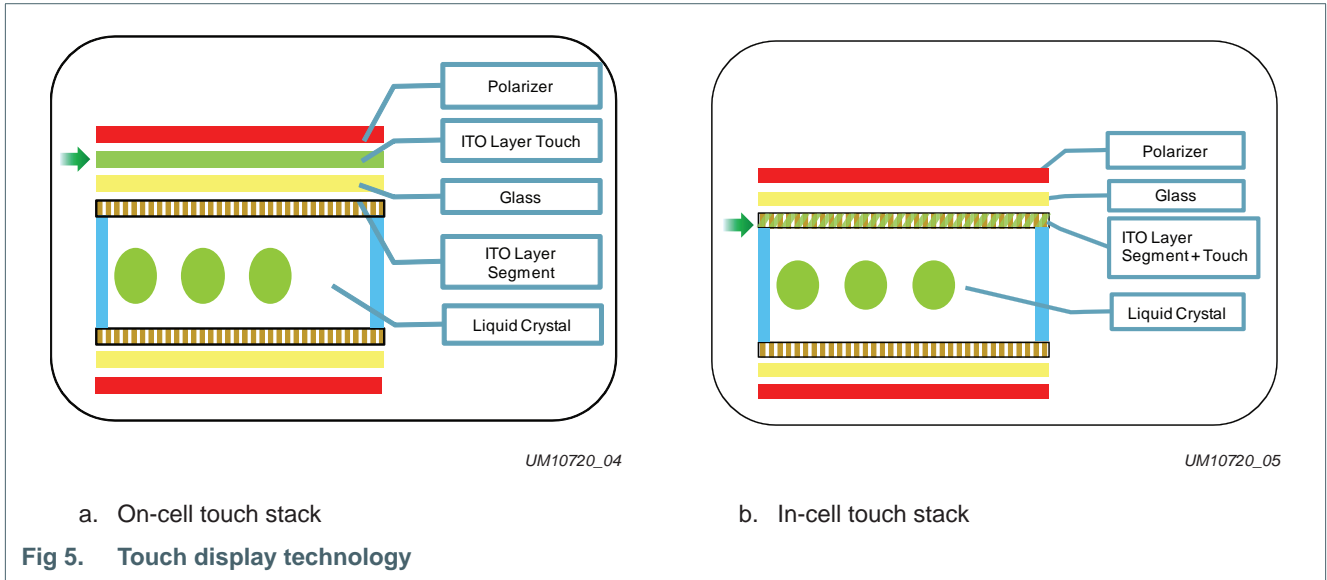
The OM11058 block diagram is shown in Figure 3.

Fig 3. **Block diagram of the OM11058**

2.1 Display layers

The basic building elements of - for example - a passive LCD are shown in Figure 4.

Fig 4.   LCD layers

The touch sensor pads can be placed on the same layer as the display ITO as an interleaved pattern (in-cell) or on top of the display glass, sandwiched under the polarizer (on-cell), see Figure 5.

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a. On-cell touch stack

b. In-cell touch stack

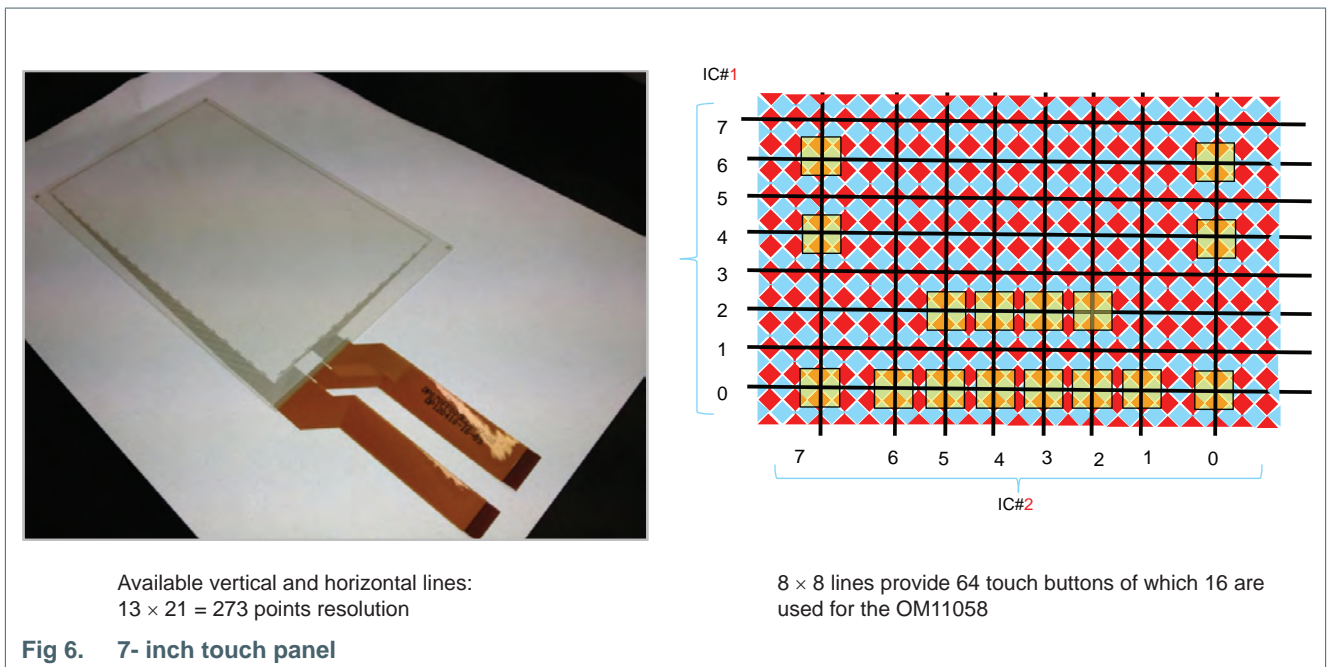**Fig 5.   Touch display technology**

The features of an in-cell stack are:

- Segment and touch ITO patterns are made in the same process step
- Lower LCD module cost
- Limited number of touch buttons can be made

For the OM11058, a separate foil with top and bottom ITO layers is used.

2.2 Touch panel

For the touch layer on the TFT display in the OM11058, a separate double sided touch foil with 21×13 diamond matrix structure was taken as an off-the-shelf product.

Available vertical and horizontal lines:
$13 \times 21 = 273$ points resolution

8×8 lines provide 64 touch buttons of which 16 are used for the OM11058

Fig 6.   7- inch touch panel

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If the sensor pads are organized in a matrix layout such as a foil with horizontally connected diamond pads on one side and vertically connected diamond pads on the other side, the sensor inputs of a single IC can be used for a 4 × 4 matrix as shown in Figure 7. For larger matrices two PCA8885 packages can be cascaded as shown in Figure 8 to locate the XY position of a touch.
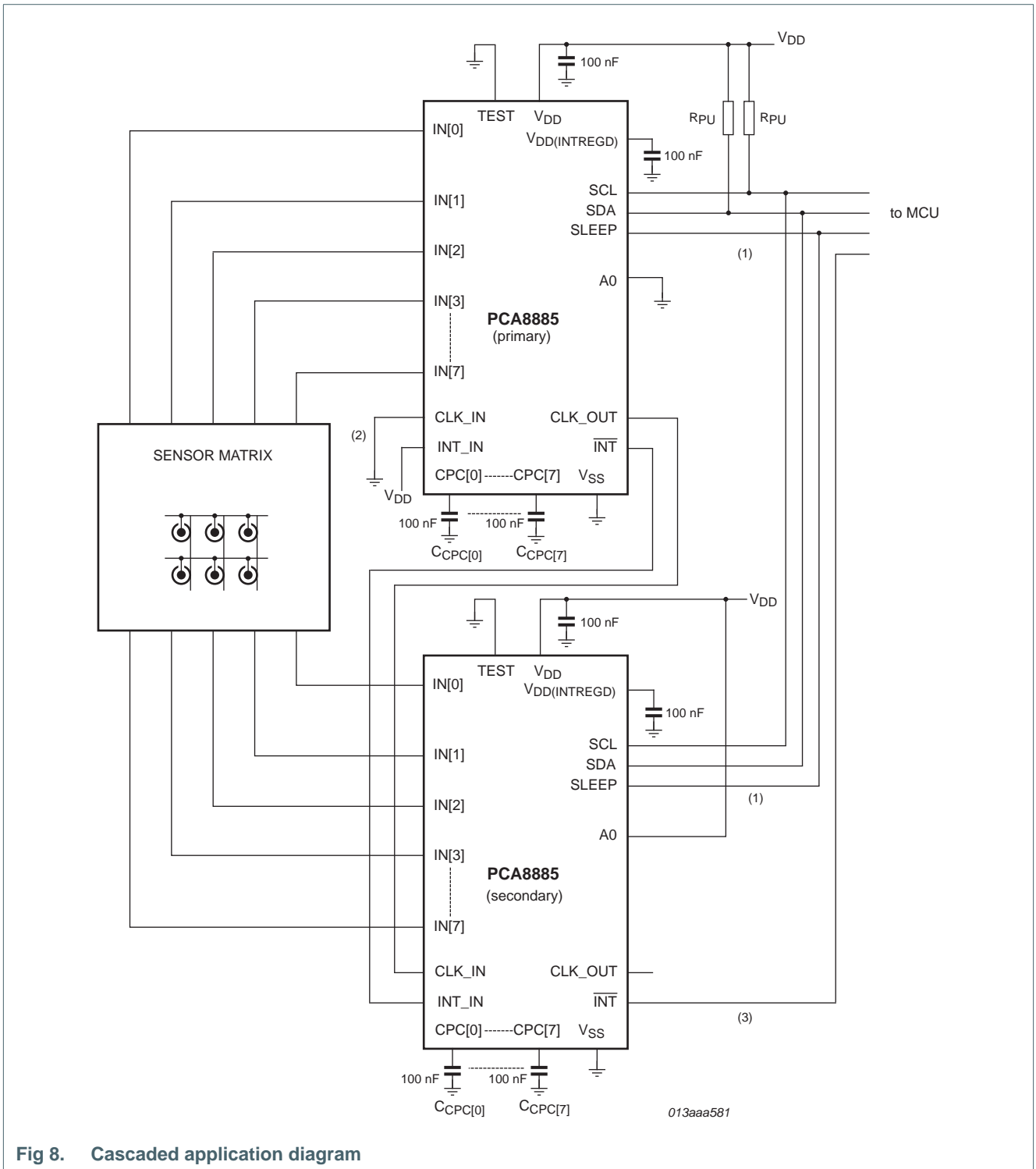

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Fig 7.   4 × 4 matrix layout

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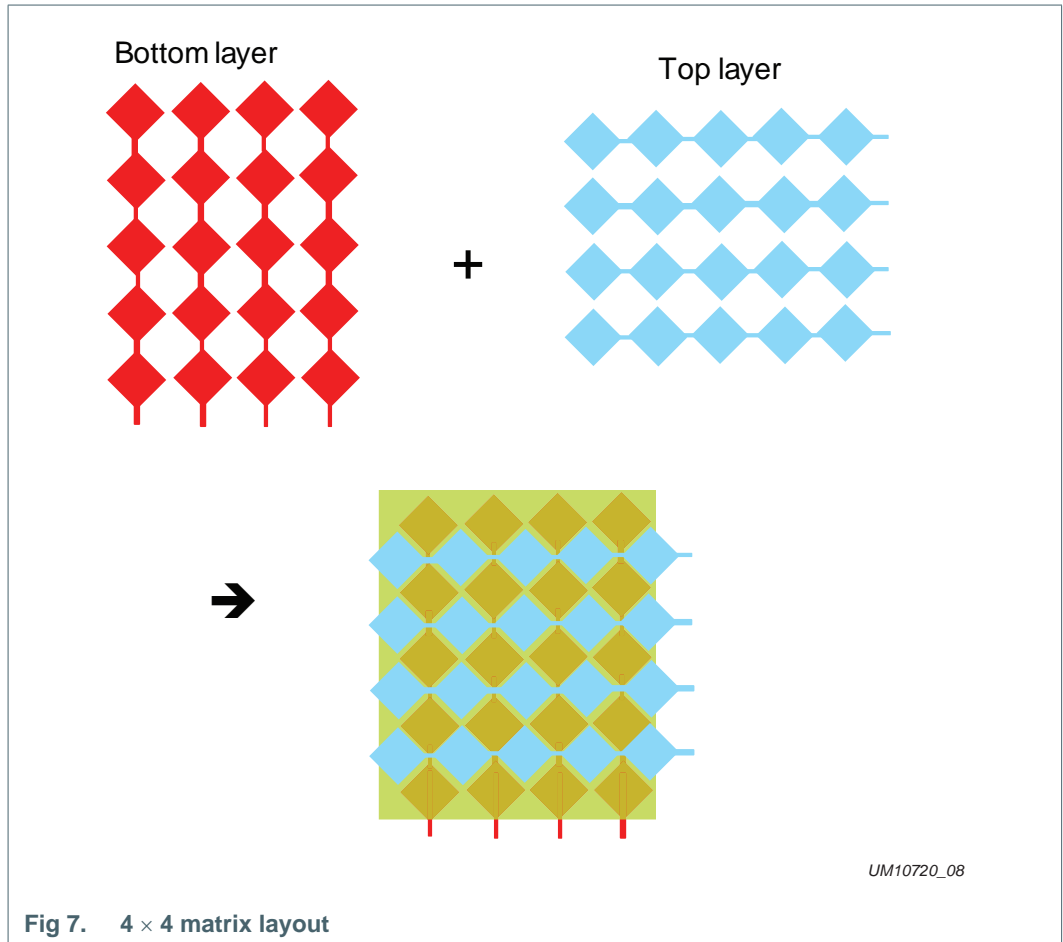
Fig 8.   Cascaded application diagram

3. Quick start

3.1 Power supply

CAUTION	
⚠	This device needs a USB source that is able to handle 2.5 A. Ensure that the USB supply connection is able to provide this amount of power. Otherwise, damages may occur.

- The OM11058 is shipped with a USB cable. The USB supply port should be able to source 2.5 A. Using the USB connector is also the option giving the highest sensitivity.
- Alternatively a AC/DC power adapter (5 V, >2.5 A) can be used. Preferably the power adapter should be a linear converter. If a switching mode AC/DC converter (SMPS) is used, it should be a three-pin connector with protective earth.

The supply connectors of the OM11058 are shown in Figure 9.

USB or power jack for supply connection

Fig 9. **Supply connectors**

3.2 Operation

- When powering up, it takes about 30 seconds to get the touch operational due to the delays in the start of the MCU evaluation board in order to get right sequence of interrupts and I^{2}C communication.
- All buttons are implemented as single switches.

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- The temperature up and down buttons (see Figure 10) are implemented as touch and hold buttons. If the touch lasts longer than half a second, the temperature steps up or down 14 steps with 200 ms intervals (the number of steps and interval is adjustable in the firmware).

Fig 10.   Touch display of the OM11058

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4. Waterproof touch display with ultra fast auto-calibration

- A liquid droplet or thick film of condensation is continuously compensated. (See http://www.youtube.com/watch?v=K7RZM8fPVlw).

- A significant water droplet or a water splash creating a film of water over a touch display or a capacitive touch control panel results in increased capacitance. However the self-capacitance measurement technique is the most efficient way of adaptability.'(See http://www.youtube.com/watch?v=CT6acNtj-5c).

- Another mechanism for capacitance change could be a magnetic or piezoelectric haptic feedback generator changing the input capacitance to different levels after every event as well as mechanical deformations. This is also automatically compensated.

4.1 Ensuring reliable operation

- Regardless of what causes a capacitive event, the most important action is to bring the capacitive sensor back to a functional state after every event: be it a real touch, a water droplet, a haptic feedback event or a mechanical movement.

- Fast auto-calibration after every touch and action ensures that the sensor is always ready for the next touch (fast auto-calibration runs 50 times faster than normal auto-calibration). This procedure takes just a few milliseconds (1 ms to 5 ms) and the sensor IC enters operation mode as soon as the fast calibration is completed, without any further intervention from the microcontroller.

5. References

[1]   **UM10370 —** User Manual for the PCF8883 Evaluation Kit OM11055; user manual

[2]   **UM10505 —** OM11057 quick start guide; user manual

[3]   **UM10664 —** PCA8885 and PCF8885 evaluation board OM11056; user manual

[4]   **UM10711 —** Slim proximity touch sensor demo board OM11052; user manual

[5]   **PCA8885 —** Capacitive 8-channel touch and proximity sensor with auto-calibration and very low power consumption; data sheet

[6]   **PCA8886 —** Dual channel capacitive proximity switch with auto-calibration and large voltage operating range; data sheet

[7]   **PCF8883 —** Capacitive touch/proximity switch with auto-calibration, large voltage operating range, and very low power consumption; data sheet

[8]   **PCF8885 —** Capacitive 8-channel touch and proximity sensor with auto-calibration and very low power consumption; data sheet

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7. Figures

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