User Manual for the PCF8883 Evaluation Kit OM11055

Rev. 03 — 24 April 2019 **User manual**

Document information

Info	Content
Keywords	Capacitive switch, sensor, proximity switch, PCF8883, OM11055, PCF8883 evaluation board
Abstract	The OM11055 is a PCF8883 evaluation board which can be used to demonstrate and evaluate the PCF8883 capacitive proximity switch. The PCB is designed to make it easy to adjust the switch's sensitivity. The board can be powered using a Mini USB cable or a 9V battery.

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Revision history

Rev	Date	Description
03	20190424	Adaptation to Microdul requirements
02	20091202	Fully updated version to reflect the change of the evaluation kit. Revision 1 was written for the preliminary evaluation board which was marked “MA142_EVALBOARD.BRD”. Revision 2 is valid for the new evaluation kit OM11055 (not marked as such on the board).
01	20090731	Initial release

Contact information

For additional information, please visit: **http://www.microdul.com/en**

For sales information, please send an email to: **info@microdul.com**

1. Introduction

This user manual describes the OM11055 evaluation kit. This board was developed in order to provide a tool for application engineers and development engineers wishing to try and evaluate the single channel PCF8883 capacitive proximity switch. A LED displays the status of the switch; test points facilitate measurements of important signals.

The desired capacitive sensor area can vary in terms of material, form, size and switching distance. Each particular switch configuration demands a suitable electrical circuit for the input signal. This board allows to easily change the input circuit and the two capacitors which define the sensitivity and reaction speed of the sensor in a typical application. This offers the opportunity to rapidly evaluate many possible switching configurations.

Features:

- Simple demonstration of the single channel PCF8883 capacitive proximity switch
- Jumper to select one of the three possible switch modes of the PCF8883
- Evaluate different sensor sizes (four different sensor plates included on the board) or off board user defined sensors
- Two power supply options: via USB cable or a 9V battery
- Provisions for through-hole components allowing them to be easily changed
- Contents of the kit:
  - One PCF8883 evaluation board
  - One 3 ft USB A-B Mini Cable
- Further documentation is available from the Microdul website:

  https://www.microdul.com/en/standardprodukte/legacy-nxp-capacitive-touch-sensors/

2. Quick start

The OM11055 is an evaluation board for the single channel PCF8883 capacitive proximity switch.

1. Apply power to the board by connecting the supplied mini USB cable to the PCF8883 board and the other end into a PC or a USB power adapter. Alternatively a 9V battery can be used. The capacitive proximity sensor is now active.
2. With no jumpers on J9 (timed mode), touching the sense plate CP1 will turn on the green output LED (LD1) for about two seconds.

Please read this manual completely for configuration options and modes.

3. Board description and layout

Below the top view of the board is shown.

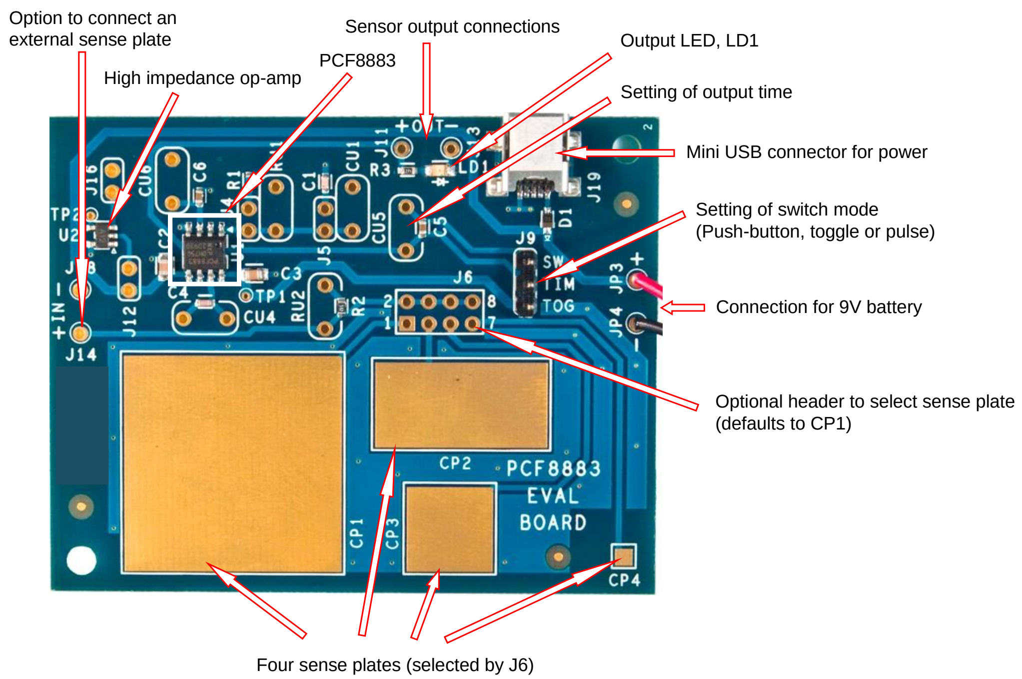

Fig 1. Top view of the PCF8883 evaluation board

The lower halve is dominated by four sensor areas of different size. The actual circuit is on the upper halve of the board. Arrows indicate the parts of interest which are described more in detail in subsequent sections.

3.1 Setting the PCF8883 operation modes

The OM11055 allows the user to set one of three output switching behaviour modes, using jumper J9. Refer to Fig 2:

a) With no jumper on J9, the PCF8883 will operate in pulse mode. The output is activated for a defined time at each capacitive event. This defined time is determined by C5.

b) With the jumper across the “TOG” and “TIM” pins, the PCF8883 will operate in toggle mode (touch on, touch off).

c) With the jumper across the “SW” and “TIM” pins, the PCF8883 will operate in momentary switch mode (push-button). The output is active as long as the capacitive event lasts.

Fig 2. Selection of operating mode using jumper J9

4. User configurable settings

The OM11055 kit allows the user to configure the PCF8883 sensor for evaluation in a specific application.

4.1 Sensor plate selection

The OM11055 board includes four sensor plates on the board itself and provisions to connect the PCF8883 to an external sensor. The board connects CP1 to the PCF8883 by default. To enable the other sensor options:

1. Cut the trace that shorts J6 pins 1 & 2 on the underside of the board.
2. Solder in a user supplied 8-pin header (0.1” pitch) at J6.
3. To select sensor plate CP4, connect a user-supplied jumper across J6, pins 7 & 8; to select CP3, jumper pins 5 & 6 of J6, etc.

To use an off board sensing plate, connect the plate at J14 & J18 using coax cable. The coaxial shield must be connected to the input pin which is marked ‘–‘. In this case do not jumper any pins on J6.

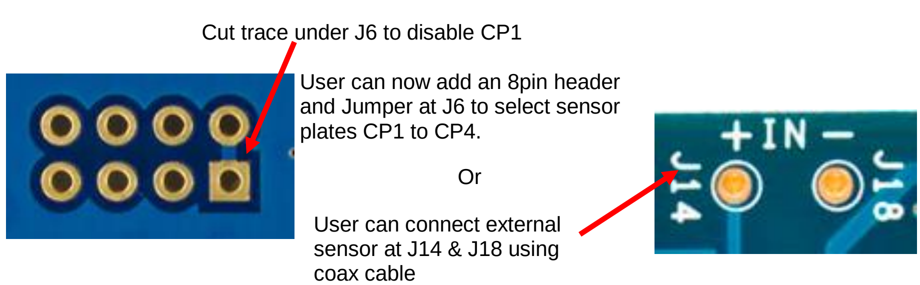

Fig 3. Sensor plate selection

The size and form of the sensor plate can be varied to obtain optimal switching behaviour or to shape the sensor for a given application.

The following figure shows some creative examples of how the switch can be used with sensors of various size and shape.

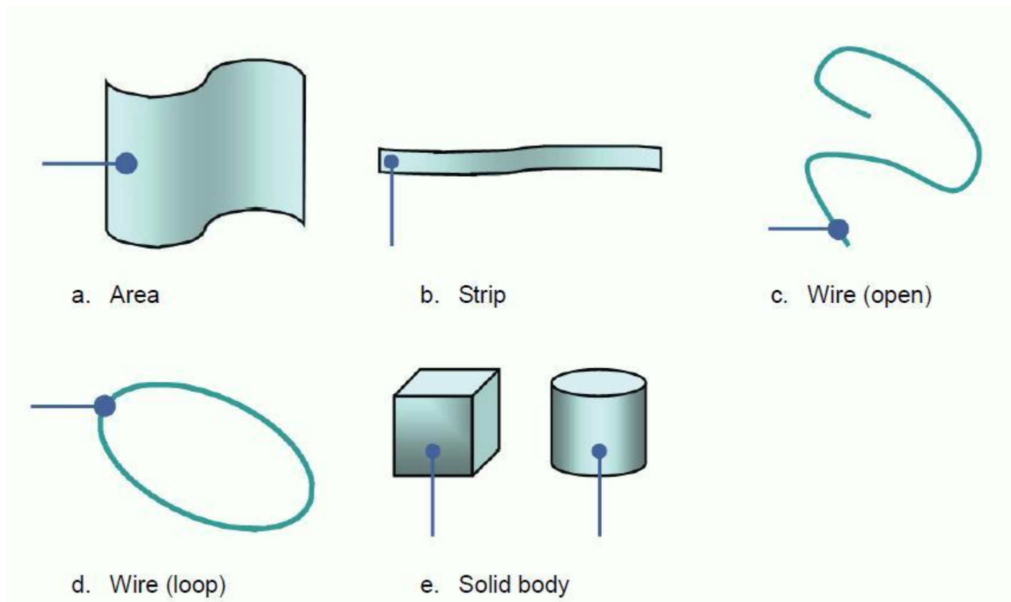

Fig 4. Examples of sensor areas and shapes

4.2 Sensitivity settings

The OM11055 board allows for easy modifications to the circuit to change the switch's sensitivity. It can be difficult to remove and install surface mount capacitors and resistors without damaging the board. Therefore the OM11055 board includes holes to add conventional through-hole passive components which enable quick evaluation of different values. To remove the SMD components R1 and C1 from the circuit, cut the trace shorts on the underside of the PCB at J4 and J5. Refer to the PCF8883 datasheet and the application note M90-31-1797 for details on adjusting the sensitivity.

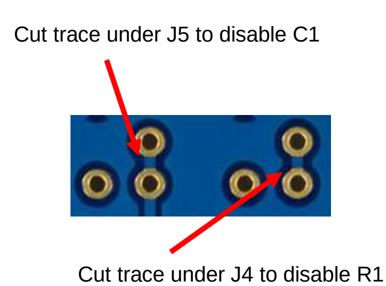

Fig 5. Traces to be cut for sensitivity setting adjustment

4.3 Power supply options

Power to the OM11055 PCB can be supplied using a mini USB cable (provided) or a 9V battery. The 9V battery connector can be removed and a user provided power supply could be connected at JP3 & JP4 for evaluation of a specific application. Using an external power supply also allows for easy measuring of the power consumption.

Warning: There is no protection against reverse polarity of the external power supply.

4.4 High impedance op-amp

A high input impedance rail-to-rail input and output op-amp (U2) is included on the board to measure the voltage at the CPC pin of the PCF8883. A capacitor is connected between pin CPC and Vss. The value of this capacitor is used to adjust the sensitivity of the switch. Since this is a very high impedance node, measuring directly with a probe would disturb the control loop. Therefore this voltage buffer has been included on the board. By default, this op-amp is not connected, as it would add to power consumption measurements. To enable U2, install two pin headers and jumpers at J12 and J16.

Remark 1: Always first provide power to op-amp U2 (jumper J12) before connecting the input to pin CPC of the PCF8883 (J16). Reversing this sequence could result in a CMOS latch up.

Remark 2: The capacitor C_{CPC} must be a good quality X7R type to minimize charge leakage.

5. Sensor adjustment

It is recommended to start the evaluation of the application using the pre-assembled components on the board since these have typical values and were tuned for use with the default connected sensor plate CP1. This should give an adequate response in most cases. In cases where the switch does not respond or responds unreliably, it is likely that the input capacitance exceeds the specified input range. The voltage measured on C_{CPC}, via testpoint TP2, should ideally be approximately ½·V_{DDREG} (note: ½·V_{DDREG} which is half the internally regulated supply voltage, not ½·V_{DD}). The bias point can be optimized by first changing C_F (and possibly also R_C) according to step 1 in the 5-step table below. Once the switch works properly, further optimizations can be done by adjusting C_{CPC} and C_{LIN}. Details concerning optimization of the biasing are given in application note M90-31-1797.

The circuit has three parameters that influence the switching behaviour. These are listed below in order of their influence:

- Switch sensitivity, set by C_{CPC}
- Calibration of the total capacitance on the sensor input using resistor R_C and capacitor C_F
- Switching speed, set by C_{CLIN}

Table 1. Optimizing step by step

Step	Component	Description	Min	Typ	Max
1	C_{IN} (C_F)	C_{IN} is the **total input capacitance** (C_{Sensor} + C_{cable} + C_F). C_F should be chosen such that C_{IN} is about 30 pF. This can be checked by measuring the voltage over C_{CPC} which should then be about ½ V_{DD}.	10 pF	30 pF	60 pF
2	R_S	R_S and C_F form a low pass filter. The typical values are likely to be correct for most applications.	-	6.8 kΩ	-
3	R_C	This resistance compensates large input capacitances (long coaxial cable, larger sensor plate area). Smaller resistor values should be used with larger input capacitances.	5 kΩ	39 kΩ	50 kΩ
4	C_{CPC}	C_{CPC} determines the **sensitivity** of the sensor. If the sensitivity is increased, the possibility of incorrect switching due to interfering electrical fields is also increased. This parameter has a strong influence on the switching characteristic.	90 nF	470 nF	2500 nF
5	C_{CLIN}	C_{CLIN} determines the internal sampling frequency and therefore the **reaction time** of the switch. Smaller values of C_{CLIN} correspond to shorter reaction times. Shorter reaction times lead to increased current consumption.	0 pF	22 pF	100 nF

6. Board schematic

On the next page the schematic of the Rev “A” OM11055 PCB is shown. Revision “A” is identified by the fact that there is no revision number on the PCB. The schematic is also available as a separate .PDF document on our website. Make sure to check our website periodically for updates.

7. References and resource URLs

The documents below provide further useful information.

1. PCF8883 product datasheet and further information
   https://www.microdul.com/en/standardprodukte/legacy-nxp-capacitive-touch-sensors/
2. M90-31-1797; PCF8883 – capacitive proximity switch with auto-calibration.

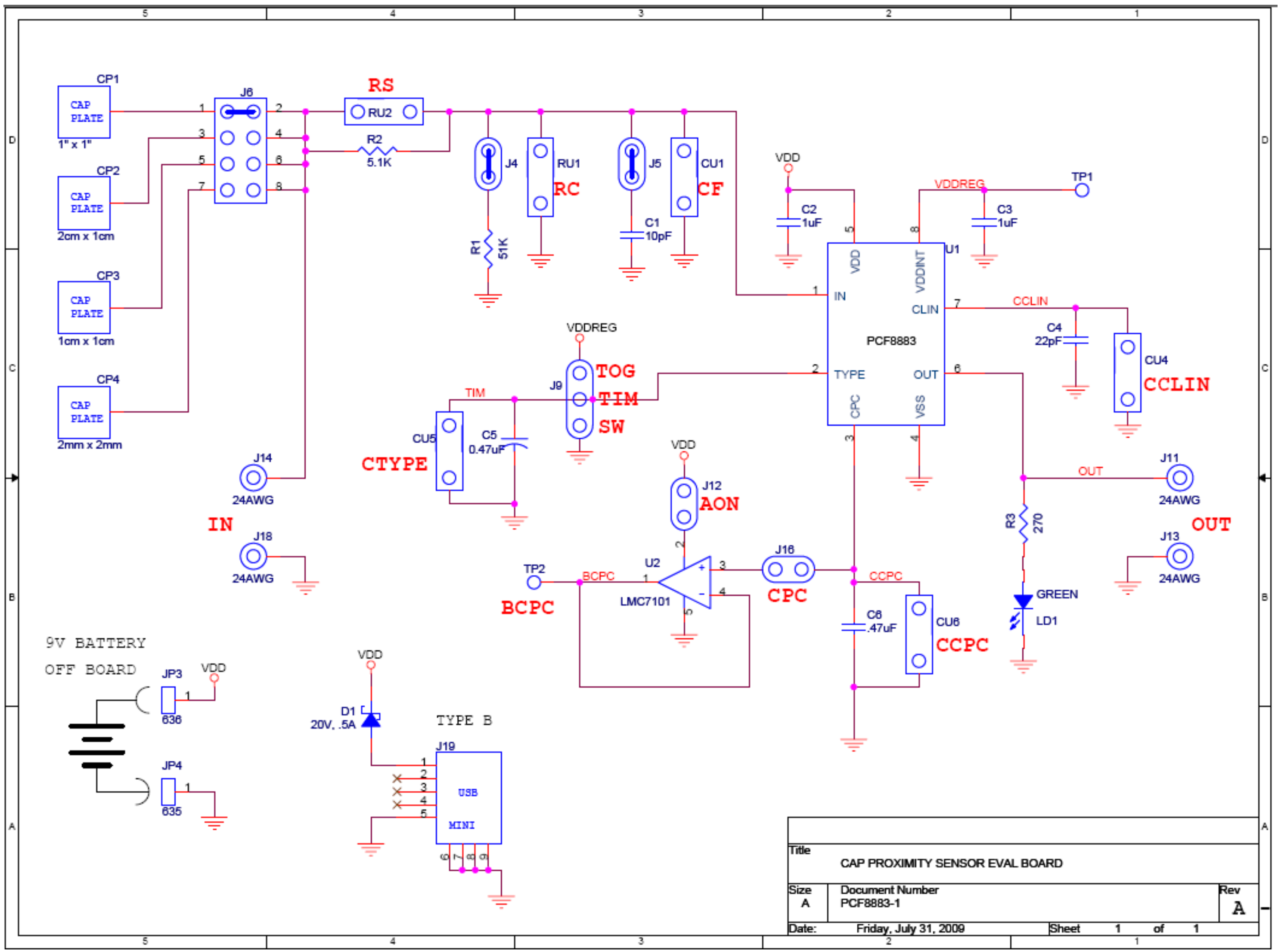

Fig 6. Schematic of OM11055

8. Legal information

This product is not designed for use in life support appliances or systems where malfunction of these parts can reasonably be expected to result in personal injury. Customers using or selling this product for use in such appliances do so at their own risk and agree to fully indemnify Microdul AG for any damages resulting from such applications.

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