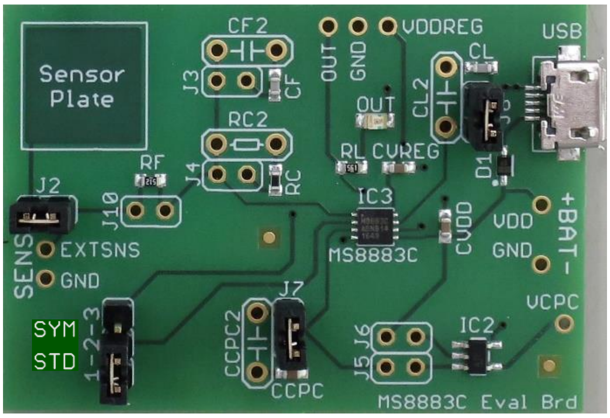
MS8883C Evaluation Board

User guide for the MS8883C evaluation board



Description

This user manual describes the MS8883C 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 MS8883C capacitive proximity switch. A LED displays the status of the switch; test points facilitate measurements of important signals.

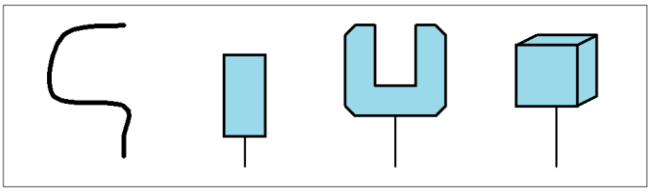
The desired capacitive sensor area can vary in terms of material, form, size and switching distance. For a quick start a sensor plate is implemented on the board. Each particular switch configuration demands a suitable configuration of the external components on the input signal and on the MS8883C. This 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:

- Demonstration of the single channel MS8883C capacitive proximity switch
- Jumper to select one of the two possible switching modes of the MS8883C
- Evaluate different sensor sizes and shapes (a sensor plate is included on the board)
- Two power supply options: via USB cable or a battery / power supply unit
- Provisions for through-hole components allowing to easily change parameters

Sensors

The following figure shows some example sensor shapes supported by the MS8883C.



References

Data sheet and further information:

https://www.microdul.com/en/ultra-low-power-sensors/capacitive-switches/

Ordering information

Article Number	Description	Contact
9160495	MS8883C Evaluation board	semiconductors@microdul.com

Tel. +41 44 455 35 11, Fax +41 44 455 35 95
http://www.microdul.com/
semiconductors@microdul.com

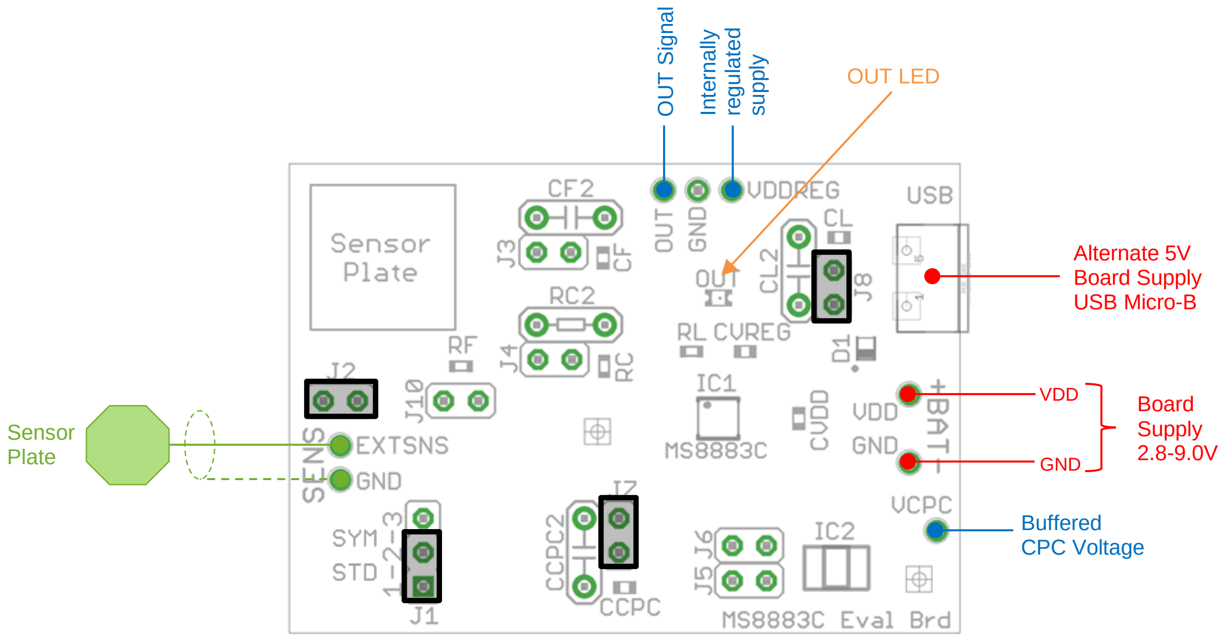
Quick start

The board is populated with the most important components with default values and an on-board sensing electrode. Jumpers are set in default positions to enable operation out of the box. A Micro-USB connector is provided to easily apply power to the board.

1. Apply power to the board by connecting a Micro-B USB cable to the MS8883C board and the other end into a PC or a USB power adapter. The capacitive proximity sensor is now active.
2. Touching the ‘Sensor Plate’ on the board will turn on/off the red LED ‘OUT’

Board description and layout

The picture below shows the assembly drawing of the evaluation:



The assembly drawing illustrates the most important connection points and the initially mounted jumpers.

The board power supply can either be provided at the connectors VDD and GND (port +BAT-, DC voltage up to 9.0V) or by connecting a USB cable to the Micro-B connector (DC 5V).

The pre-assembled SMD capacitors CCPC, CL, CF and the resistor RC have default values and may be enabled by placing the related jumpers J7, J8, J3 and J4. For experimenting with your own component values, through holes are available to mount THT components CCPC2, CL2, CF2 or RC2. Initially, the SMD components CL and CCPC are enabled with jumpers J7 and J8.

Important: The CPCC/CCPC2 capacitor must be a good quality X7R type to minimise leakage.

The jumper J1 allows to select the output switching dynamic of the MS8883C. With a jumper set in position 1-2 of J1 the standard asymmetric mode is selected. With a jumper set in position 2-3 of J1, the symmetric behaviour is selected. Initially a jumper is set at position 1-2 of J1.

For first experiments, there is an on-board sensor electrode ‘Sensor Plate’. This on-board electrode is initially selected by a jumper on J2. An external electrode with arbitrary shape and size can be attached at the EXTSNS point. An additional GND connection is possible to optionally shield the cable to the electrode. If an external electrode is used, jumper J2 should be removed to disconnect the on-board ‘Sensor Plate’.

Tel. +41 44 455 35 11, Fax +41 44 455 35 95
http://www.microdul.com/
semiconductors@microdul.com

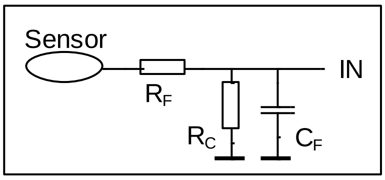
To measure the operating point of the MS8883C, there is an operational amplifier IC2 of type LMC7101 mounted on the board to buffer the sensitive CPC signal. In order to use the OpAmp, both jumpers J5 and J6 must be populated. In this case, the power consumption of the OpAmp adds typically 500 µA to the power consumption of the MS8883C. The jumpers J5 and J6 should only be placed or removed when the board is not powered.

The sensor compensation section below covers the effects of changing the component values.

Sensor compensation & sensitivity tuning

It is recommended to start the evaluation using the pre-assembled components on the board, since these have typical values and should give an adequate response in many 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 the CPC line should ideally be close to VDDREG/2, which corresponds to a total capacitance of the sensor and connection lines of 20 – 30 pF. The bias point can be optimised by adding capacitance to the IN line (CF) or by adding a pull-down resistor to the IN line (RC), according to step 1 in the table below. Once the switch functions properly, further optimisation can be done in a second step by adjusting CCPC and CL.

Step	Component	Description	min	typ	max
1	optional external components				
	CF	The **total input capacitance** (CSensor + Ccable) to ground is ideally about 20 - 30pF. The voltage at CCPC should then be about VDD/2. If the input capacitance is too small, an additional capacitor CF should be added between the sensor input IN and GND.	10pF	30pF	60pF
	RF	RF and CF form a low pass filter. The typical value is likely to be correct for most applications. If RF is too large in some case, it can be short-circuited with jumper J10.		5.1kΩ	
	RC	A discharge resistor RC may be added, if the input capacitance (CSensor + Ccable) is too large (large sensor, long coax connection). Smaller resistor values should be used for larger input capacitances. In this case CF should not be applied. Again the criteria is to reduce the voltage over CCPC to approximately VDD/2.	10kΩ	39kΩ	
2	CCPC	CCPC determines the **sensitivity** of the sensor. The sensitivity can be increased by adding CCPC2. This capacitance has a strong influence on the switching characteristic. The maximum value of 2500nF is no strict limit, but larger values increase the likelihood of incorrect switching due to interfering electrical fields. The sensitivity of each channel can be set individually by choosing the optimal capacitance value.	90nF	470nF	2500nF

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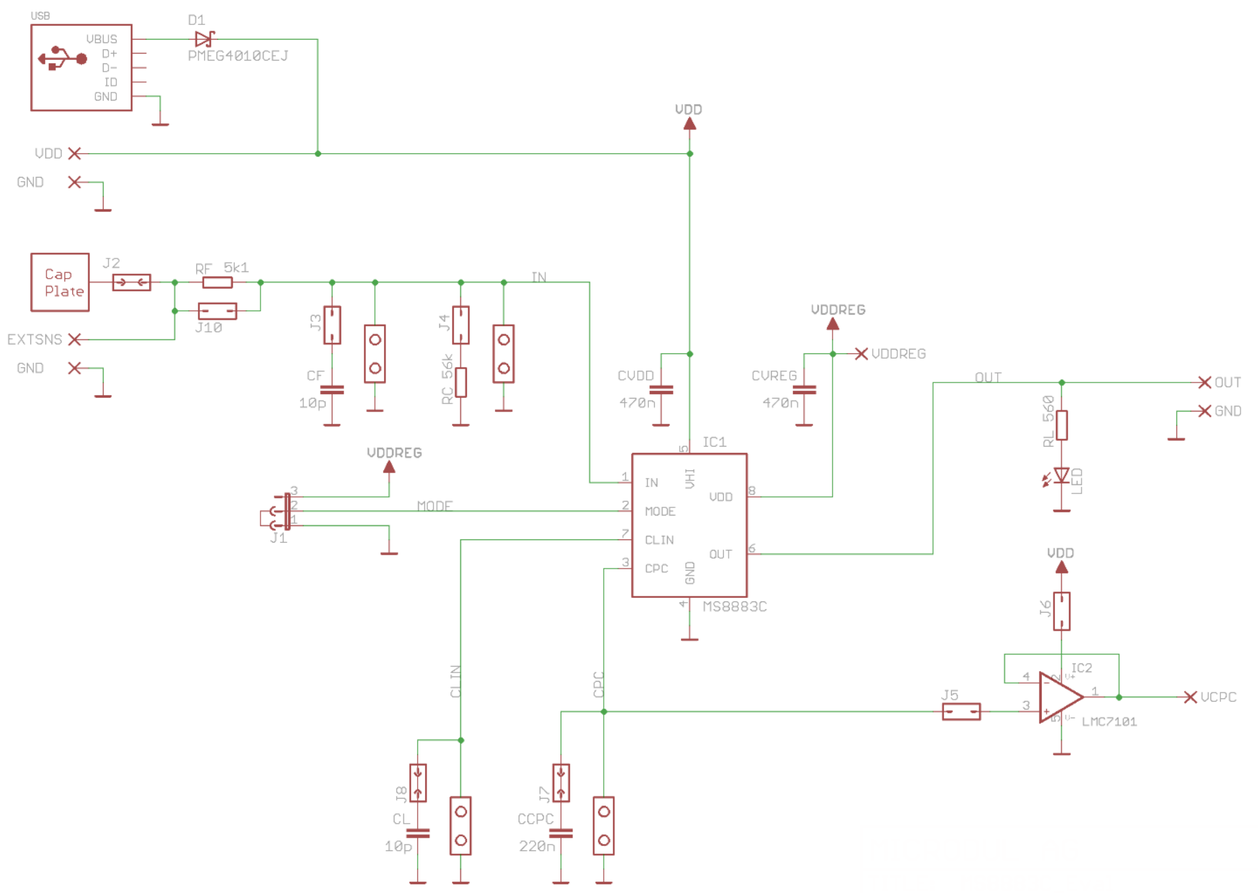
		The initially placed CCPC has a value of 470nF. If the sensitivity has to be reduced, this capacitor must be replaced with a smaller value. This can easily be achieved by removing jumper J7 and placing a THT component in CCPC2.			
3	CL	CL determines the internal sampling frequency and therefore the switch **reaction speed**. Smaller values of CL correspond to faster sampling and thus shorter reaction times. This in turn leads to increased current consumption. Fast sampling also leads to faster auto-compensation of small or slow changes. Slow capacitance changes, caused for instance by very slowly approaching fingers, may be compensated and the sensitivity may appear reduced. The value of CL should be optimised to achieve the preferred switching dynamics.	0pF	22pF	100pF

Circuit diagram



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http://www.microdul.com/
semiconductors@microdul.com

Bill of material

The evaluation board is populated with the following components:

Item	Description	Value	Package
IC1	MS8883C 1-channel capacitive switch		SOIC-8
CCPC [1]	SMD capacitor, sensor sensitivity setting	470 nF **X7R**	C0603
C_VDD, C_VDDREG	SMD capacitor, supply decoupling	470 nF	C0603
CL [1]	SMD capacitor determining the sampling frequency	10 pF	C0603
CF [1]	SMD capacitor, input (filter) capacitor to increase the input capacitance if needed	10 pF	C0603
RC [1]	SMD resistor to compensate large input capacitances	56 kΩ	R0603
RF	SMD resistor, input R-C filter resistor, can be bypassed with jumper J10	5.1 kΩ	R0603
RL	SMD resistor, LED current limiting	560 Ω	R0603
LED	LED indicating the output state of the MS8883C	red	0805
IC2	LMC7101 operational amplifier to buffer the CPC voltage for operating point measurement		SOT23-5

Legal disclaimer

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.

[1] For this item an SMD component is pre-mounted, which can be connected by a jumper. Additionally, there are mounting holes to place THT components, in order to experiment with the component values. For CL and CCPC the enabling jumpers are already mounted.

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