UM10699

User manual for SPI-bus RTC demoboard OM11059UL

Rev. 3 — 18 August 2020 User manual

Document information

Information	Content
Keywords	PCF85063BTL, OM11059UL, demoboard, how to get started, SPI-bus, RTC, Real-Time Clock, tuning
Abstract	User manual for the RTC SPI-bus demoboard OM11059UL which contains PCF85063BTL

Revision history

Rev	Date	Description
v.3	20200819	Added Section 6; changed "OM11059" to "OM11059UL" throughout
v.2	20150212	revised version
v.1	20130404	Initial version

1 Introduction

The PCF85063x are a family of CMOS Real-Time Clocks (RTC) and calendar optimized for low power consumption. Different features sets are available.

The OM11059UL is the ideal evaluation/demo board to use in the design phase of any project, just power and SPI-bus must be hooked up.

A separate demoboard and a user manual are available for the I^2C-bus RTCs PCF85063AT:OM13515 and UM10788.

2 Key features

The RTC PCF85063BTL with SPI-bus is mounted together with a quartz crystal and the blocking capacitor, buffering the supply voltage.

2.1 PCF85063BTL

The RTC PCF85063BTL is a Real-Time Clock with very small form factor, counting seconds, minutes, hours, days, weekdays, months, and years.

Electronic oscillator tuning

RAM: 1 Byte

Package: HXSON10 package: 2.6 x 2.6 x 0.5 mm

Alarm control

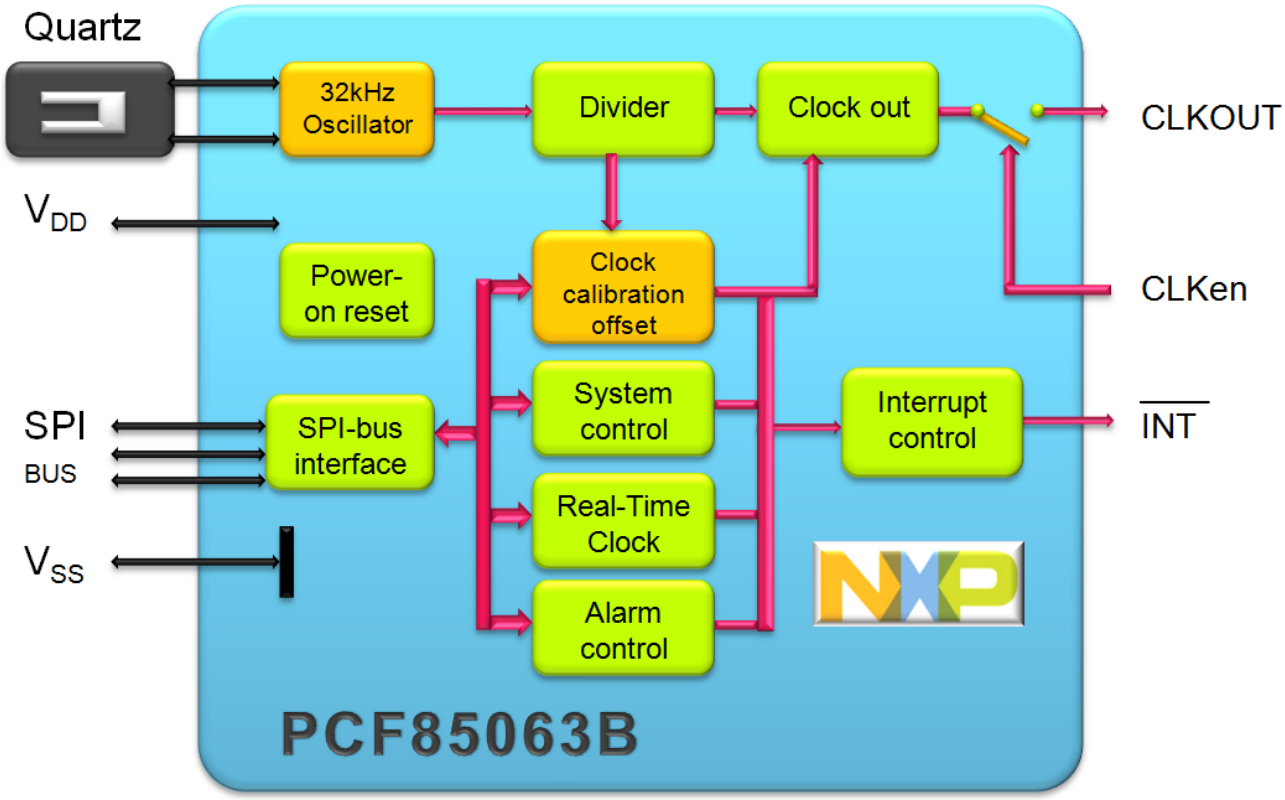
Timer

Interrupt: every 30 s or 60 s, alarm, timer

Interface: SPI-bus, up to 8 MHz

Clock out: enabled by pin or by software

Table 1. Block diagram of the PCF85063BTL RTC



3 Hardware set-up

3.1 General requirements for the RTC PCF85063BTL

The RTC circuit just requires one external part: a tuning fork quartz as resonator. The oscillation capacitors are integrated and therefore there is no need for external capacitors. The quartz crystal must be placed close to the RTC circuit, avoiding long lines which may pick up noise. Avoid any tracks with high frequency signals (fast edges) close to the RTC, quartz, or quartz interconnect.

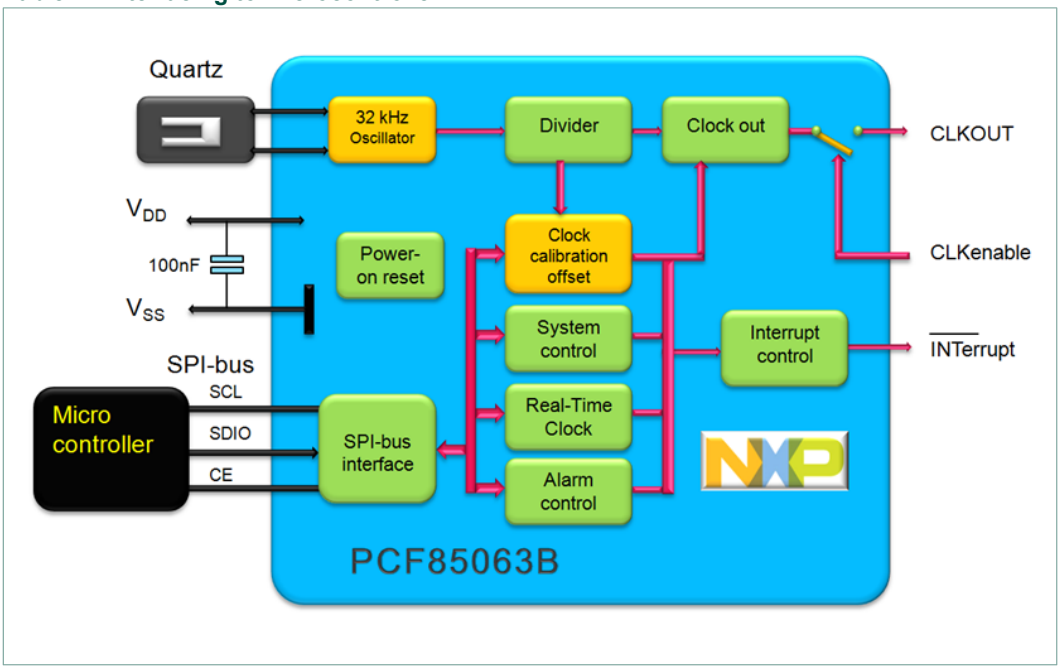
The interface uses a three-line standard SPI protocol: chip enable, serial clock, serial data I/O operating up to 8 MHz.

Supply voltage: The RTC is specified from 1.8 V to 5.5 V. The RTC, excluding the SPI-bus interface, is however operating down to a lower voltage. It is recommended to have a decoupling capacitor on the VDD-VSS rails close by.

Due to the low power consumption of below 1 µW, no precautions for heat dissipations are required.

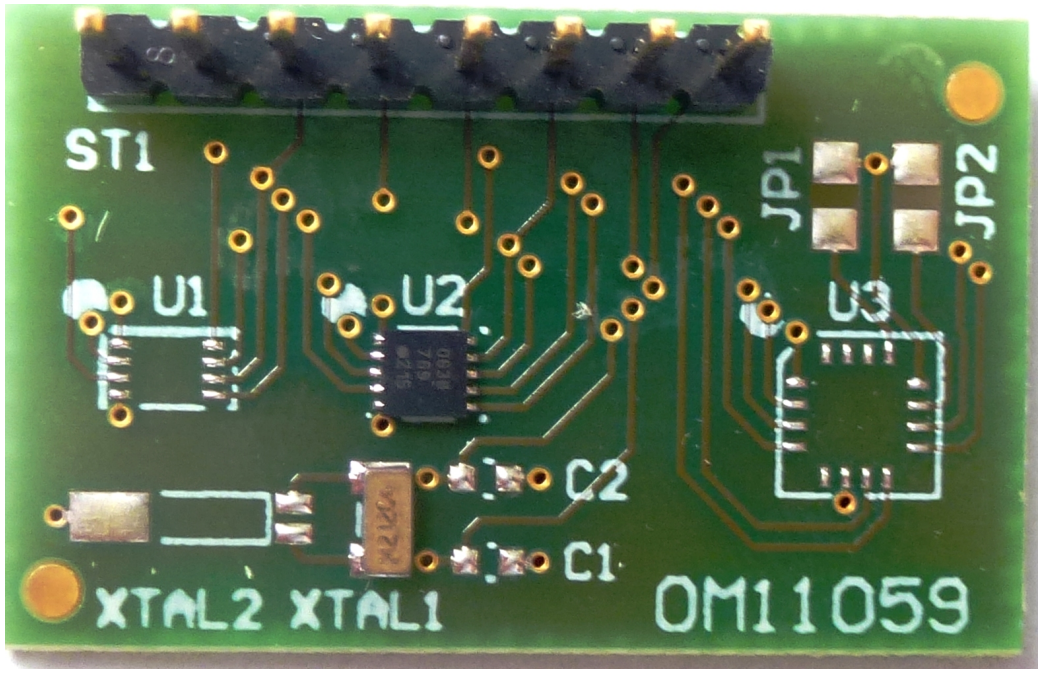
CLKOUT can be used to measure the frequency or be used as reference for frequency generation with a PLL.

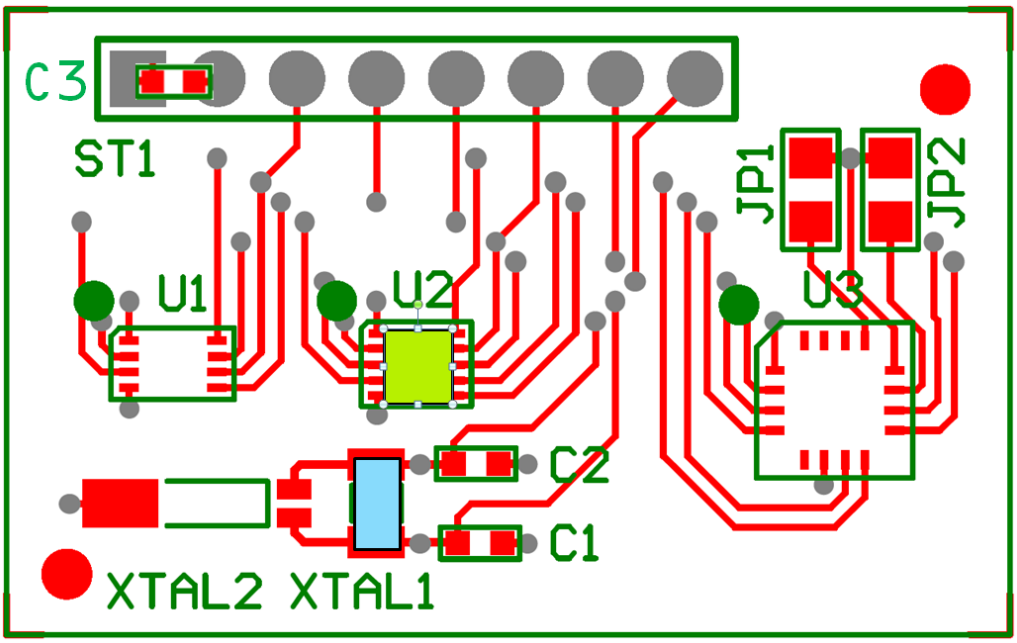
Table 2. Interfacing to microcontroller



3.2 Demo board OM11059UL

Table 3. Picture and layout of demo bard OM11059UL





The OM11059UL allows to easily demonstrate operation of the PCF85063BTL with SPI-bus interface. No need to solder the tiny package to a breadboard 100 mil connector for straight forward connections.

There are quartzes on the market with different load capacitance C_L. 12.5 pF is most common, 7 pF offers however lower power consumption. By default a quartz with 7 pF is mounted. Additional landing pads are available on the board to take a quartz in a tubular package.

Straight forward interfacing:

- Connect supply voltage (e.g. 3.3 V): VSS to pin 1, VDD to pin 2 - Connect SPI-bus: CE to pin 4, SCL to pin 3, SDI/O to pin 7 - Communicate to the RTC

Table 4. OM11059UL block diagram

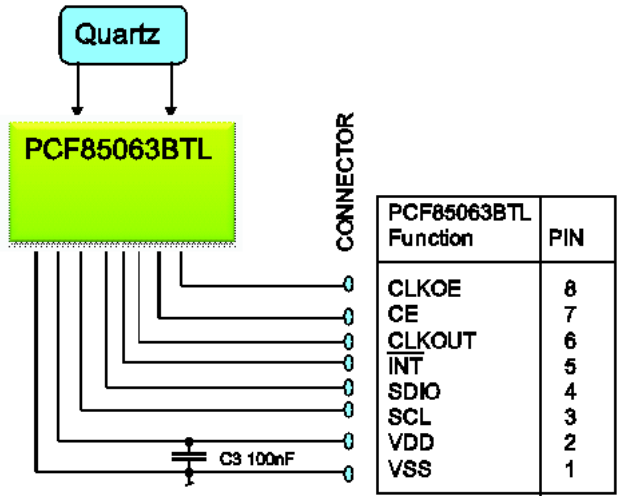
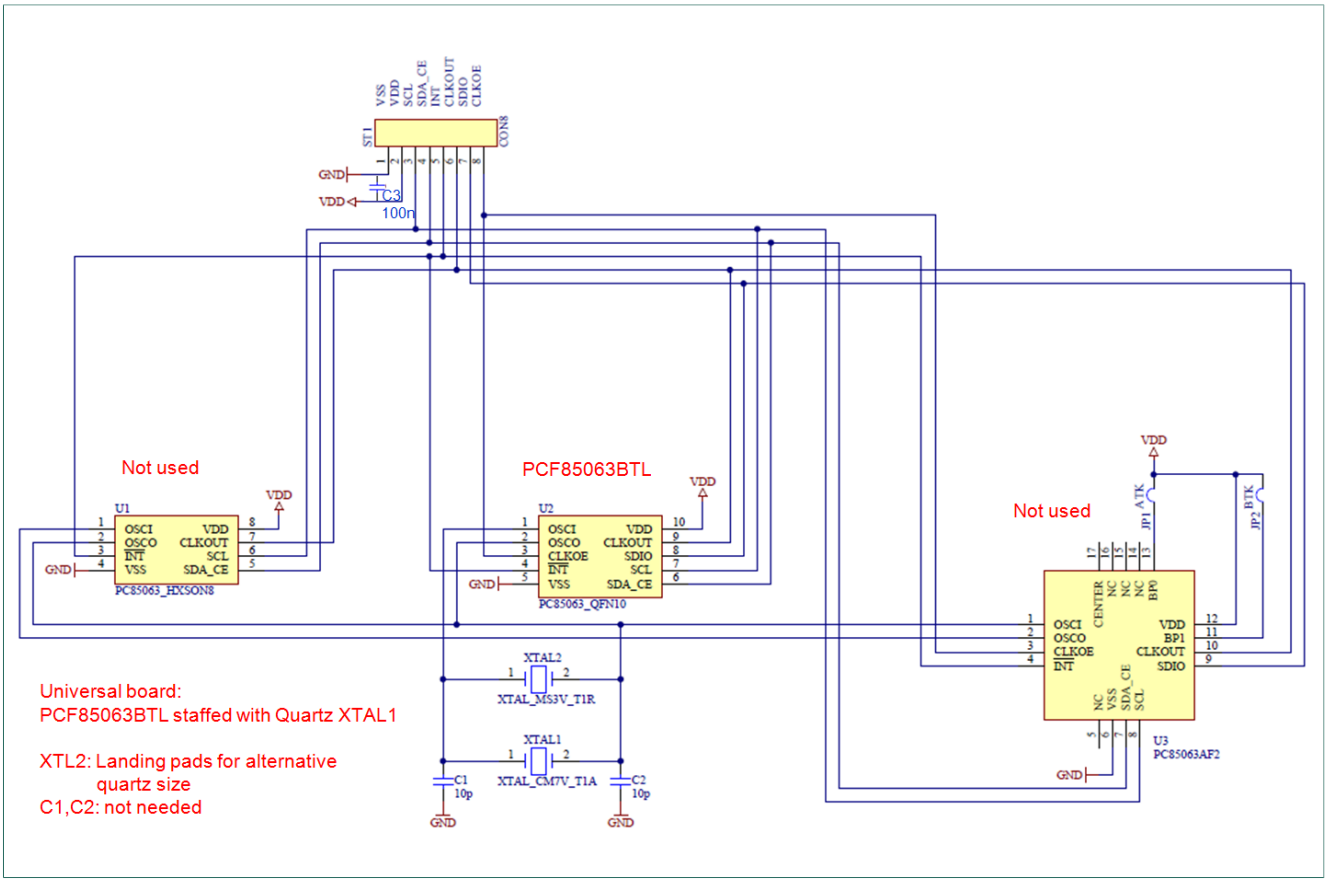


Table 5. OM11059UL schematics



4 Software set-up

4.1 Functionality

The RTC PCF85063BTL is controlled via standard SPI-bus interface. Common SPI protocol applies.

Theoretically there is no lower speed limit, however a read or write access to the RTC must be finalized within one second after initiating it, otherwise time counter increments could be lost. During access, the time registers of the RTC are frozen and after the read or write sequence is completed, a seconds increment is executed if required.

The clock tracks the actual time from seconds to year. It must be initially set to the correct time of the actual time zone. The days per month and leap year are corrected automatically. Leap years are assumed whenever the year is dividable by 4.

The RTC can be programmed to generate an interrupt every 30 seconds or every 60 seconds.

At address byte 03h is a general purpose RAM byte to store temporary information.

4.2 System testing

There is a fast mode facility to test the functionality of the RTC; it can be activated by setting the EXT_TEST bit in the Control_1 word.

The RTC PCF85063BTL has a frequency tuning facility; its operation is explained in section 5.

The RTC can stay switched on all the time. There is no need to restart or reset the clock.

4.3 Software instructions for setting the clock

4.3.1 Setting the time

Table 6. Setting the clock to 3.45 pm February 14, 2015

Name	Address	Setting
CE		chip enable
Register address	0000 0000	address pointer to status word 0
Status word 0	0000 0011	set 12 hour mode and select option for 12.5 pF quartz
	0000 0010	set 12 hour mode and select option for 7 pF quartz
CE		chip disable
CE		chip enable
Register address	0000 0100	address pointer to seconds register
Seconds	0000 0000	0 seconds (clock integrity ok → MSB OS = 0)
Minutes	0100 0101	45 min
Hours	0010 0011	PM, 3 (clock integrity ok → OS = 0)
Days	0001 0100	14th day of month
Weekdays	0000 0110	Saturday (6th day of the week)
Month	0000 0010	February
Year	0001 0101	(20)15
CE		chip disable

4.3.2 Reading the clock

Table 7. Reading the clock (2 minutes after writing)

Name	Address	Setting
CE		chip enable
Register address	0000 0100	address pointer to seconds (R/$\overline{W}$; bit = 1)
Read register 4, seconds	. . . . .	e.g. 56 Seconds, (clock integrity ok → OS = 0)
Minutes	. . . . .	e.g. 46 (minutes)

Name	Address	Setting
Hours	. . . . .	e.g. 03 (PM 03h)
Days	. . . . .	e.g. 14 (14th)
Weekdays	. . . . .	e.g. 06 (Saturday)
Month	. . . . .	e.g. 02 (February)
Year	. . . . .	e.g. 15 (20)15
CE		chip disable

5 RTC tuning

5.1 Frequency tuning

The 32 kHz quartzes are typically sold with a tolerance at room temperature of either ±10 ppm or ±20 ppm. 11.5 ppm corresponds to 1 s/day.

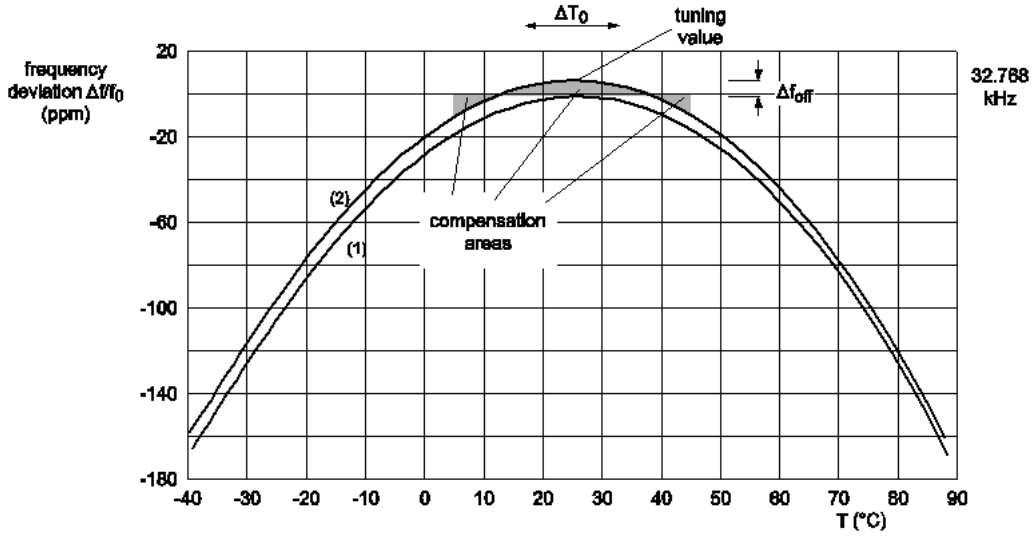
The quartzes require a characteristic load capacity of either 7 pF or 12.5 pF. Oscillators utilizing 7 pF quartzes feature slightly lower power consumption, where the quartzes of 12.5 pF have largest production quantities. The tracks between quartz and RTC represent also some parasitic capacitances and must be kept short.

The PCF85063 has a tuning facility where above tolerances can be compensated. Tuning procedure:

- Measure the 32xxx Hz (f) signal at the CLKOUT pin.
- The offset is calculated in ppm as: $\Delta f_{[ppm]} = 10^6 \times (f - 32768) / 32768$
- Consult the offset table in the data sheet. Take the correction value and write it into the register 02h.
- The correction is done by means of inhibition or addition: the oscillator runs at constant speed, then every 2 hours (mode 0) 1 second is corrected to by making it shorter or longer. This is not easily visible at the CLKOUT.
- Corrections can also be applied every 4 minutes by using mode 1. This mode will consume slightly more power.

The 32 kHz quartzes are of the type tuning fork and feature a parabolic frequency response over temperature. When the application is dominantly used over a limited temperature range, it is often helpful to tune the frequency to be slightly higher at the turn-over point. The error around 25 °C (clock goes too fast) is then compensated during the time when temperature is lower or higher. For example, for operation between 5 °C and 45 °C, tune the clock 8 ppm faster than the value for 25 °C would be. (Fig 6.)

Table 8. Temperature averaged over application range 5 °C to 45 °C



1. Characteristic if tuned to 32.768 kHz at 25 ºC.
2. Characteristic if tuned with the positive offset Δf_{off}.

6 OM11059UL Board FCC-CE EMC Position

Author: Jim Hornig, Board Solutions Compliance Engineer, NXP Semiconductors, 8 July 2020

Scope

This documents NXP Semiconductors' position regarding the applicability of FCC and CE EMC requirements on the OM11059UL board.

Applicability

This document applies only to the OM11059UL board as defined by the documents in Agile for the Marketing PN OM11059UL.

Product Description

The OM11059UL board consists of a custom Printed Circuit Board (PCB), passive components (capacitors, resistors), pin headers/connectors for external connection, and the associated PCF85063BTL tiny Real-Time Clock/calendar with alarm function and SPI-bus. The boards require an external power source.

When power is applied to the board(s), the PCF85063BTL device will power-up to a quiescent no-operative state as there is no Micro-Controller Unit (MCU) to operate the device. As such, the OM11059UL board is considered non- functional.

The purpose of the board is to allow customers to evaluate function of the PCF85063BTL device based on how the customer manipulates the inputs on the board.

Overview and Position

Based on our review of the documentation in Agile for OM11059UL; the OM11059UL board is considered a non- functional component. Since it is non-functional as sold, it is considered a component from an FCC and CE perspective and formal testing does not apply.

Marking and Documentation Requirements

From a legal perspective, the following requirements apply:

User Guide

The following text needs to be included in the OM11059UL user guide:

> This product has not undergone formal EU EMC assessment. As a component used in a research environment, it will be the responsibility of the user to ensure the finished assembly does not cause undue interference when used and cannot be CE marked unless assessed.

Product Packaging

The outside of the OM11059UL box must be labeled with 805-77385 the following text:

> For evaluation only; not FCC approved for resale

An insert 926-78954 with the following text needs to be included with the OM11059UL board:

> FCC NOTICE: This kit is designed to allow:
> (1) Product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and

(2) Software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

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