SERMA
PRODUCTIVITY ENGINEERING

Documentation

Demoboard-EVA5004v3
User Guide

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1 Revision History

Version	Date	Changes	Page
Initial Version V1.0	07/2011		

2 Overview

The Demo- and Evaluationboard - EVA5004v3 is especially designed to evaluate the PE5004 Capacitive Sensor Matrix Controller IC of Productivity Engineering GmbH. The board demonstrates the use of the chip for applications where buttons and sliders can be implemented behind protective plastic or glass. It features 16 touch buttons and one slider. Each touch button has an LED to display the sensed touch. The slider status is displayed on a 7-segment LED.

The EVA5004v3 serves as a demonstrator and evaluation kit with the following features:

- PE5004 for capacitive sensing
- µC ATMEGA8a (firmware for EVA5004v3 board available)
- 7-SEG-LED display
- 4x4 Touch Matrix with 4x4 indicator LEDs
- Slider (6 sensors)

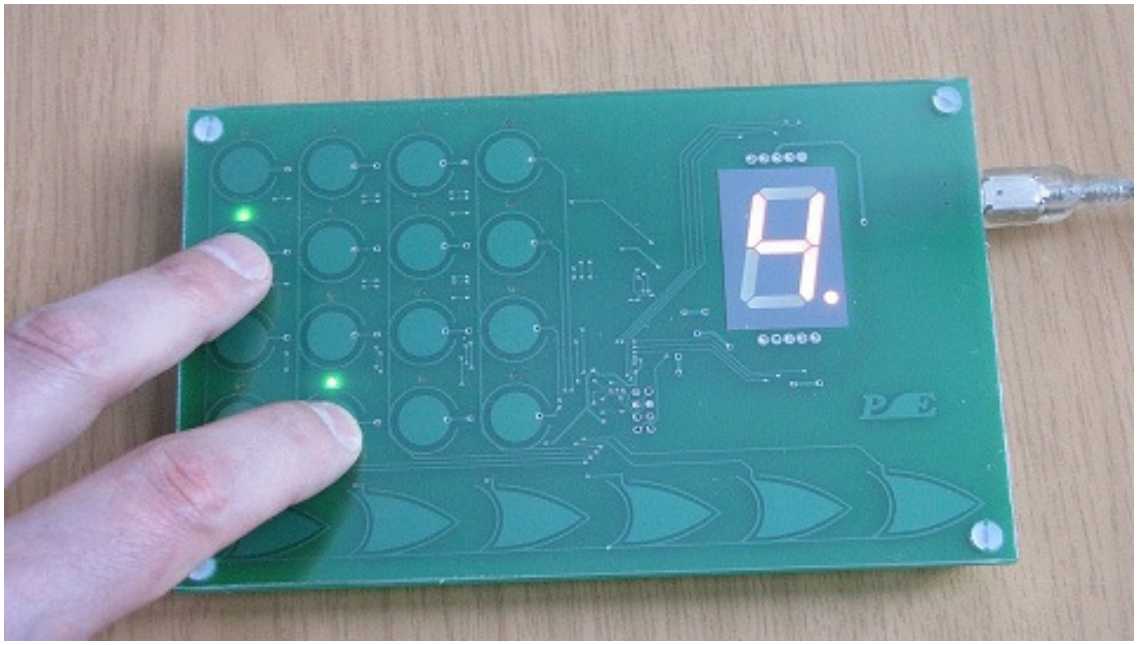


Figure 1 – DEMOBOARD EVA5004v3

3 Introduction to EVA5004 Hardware

3.1 PE5004 General Description

The PE5004 is a high precision capacitive sensing circuit which uses amplitude modulation for very fast stimulating and reading of capacitive sensor arrays and self capacitance sensors. A number of up to 100 sensors per chip can be selected by the user and multiple sensor arrays can be cascaded. By implementing a controllable sine wave generator with a wide range of frequencies and amplitudes the spectrum of suitable sensor capacitances is significantly increased for a large range of applications. The implemented DAC with variable reference voltages guaranties proper function over varying environmental conditions and provides digital controlled self calibrating capability. A sleep mode with ultra low standby current and programmable wake-up intervals is implemented for low power operation. Additionally the power consumption of internal blocks can be programmed to a third of its normal value if full 10bit-resolution is not necessary or large sensor shapes are used. Several detector circuits can be controlled by one MCU by means of a multimaster I²C interface.

3.2 Features of the PE5004

- Suitable for two capacitive measurement styles:
  - Sensing of small capacity changes in 10x10 mutual capacitance sensor arrays
  - Sensing of self capacitance changes in approximation and touch sensor applications
- Controllable stimulation to adopt for the wide spread of suitable sensor capacitance, layout and material
- Highly sensitive, coating thickness of over 30mm for self capacitance sensors possible
- Very fast acquisition time of 15ms for 100 sensors in a matrix
- High resolution of 10bit for each sensor
- Sleep mode with programmable wake up intervals
- Low operating current (< 3mA at max. speed)
- Low-Power Mode for large sensor shapes
- Very low standby current during sleep (1µA)
- Number of sensors can be programmed for optimal acquisition time and current consumption
- Grounding of scanned object not necessary
- No need for sampling capacitors or external resistors
- Very robust against noise
- Temperature drift compensation
- Multiple PE5004-based sensor arrays controllable with one µC:
  Up to 700 sensors through I²C, up to 2000 sensors through SPI

4 Description of EVA5004v3

The EVA5004v3 is especially designed to demonstrate the unique capabilities of the PE5004 Capacitive Sensor Matrix Control IC of Productivity Engineering GmbH. The board has a USB power connector. After power up the board calibrates all sensors and displays the “5” in the 7 segment LED display. Now each button can be pressed and the capacitive change caused by the finger will be recognized by the controller. The controller then drives the 1:16 decoder to display the on-off status of the related LEDs. The decoder output drives one LED. The input needs to be multiplexed since only one output can be active at a time. To demonstrate the multitouch functionality of the PE5004 it is required to virtually turn on more than 1 LED at a time by fast changes of the input signals of the decoder. A controller with one additional 8 bit port or a different external circuit would be required in an application with e.g. relay switches.
The slider on the demo board decrements or increments a number on the 7-segment display which is directly connected to a MCU port.
In order to prevent a failed calibration, the sensor fields or the near of the fields should not be touched during power on.
The sensor field can also be made insensitive to water drops by certain programming algorithms that dynamically adjusts the threshold level of the sensor buttons. The board has shown no sensitivity to EM fields emitted by cell phones. However, the PE5004 allows adjusting of the stimulating sensor frequency. For more details regarding the capabilities of the PE5004 please refer to the data sheet.

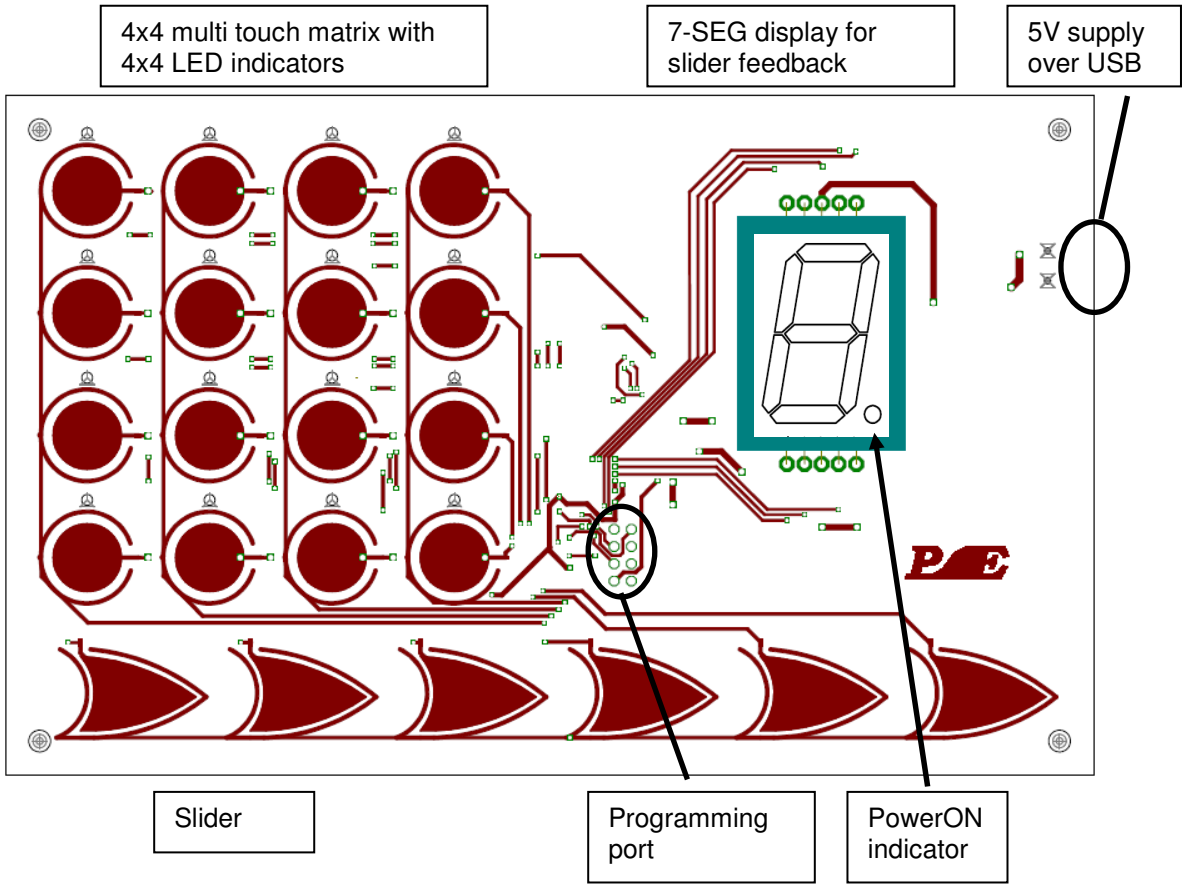
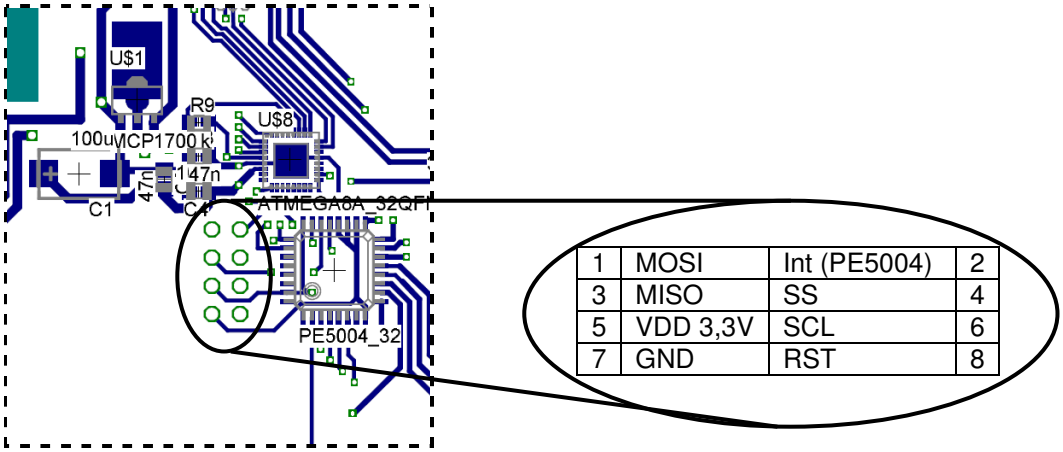


Figure 2 – EVA5004v3 board functional blocks

The program code (available for download) has routines implemented to verify the threshold levels and other settings for optimum sensing performance. Please be aware that it is not possible to use a PC terminal program via USB on this board to verify sensor or setup information of the PE5004. For programming the PE5004 a special connector as outlined in paragraph 4.1 can be used. Ensure that the front cover is dismounted before soldering a connector.
The LEDs shall not be turned on or off for EMI and power drop reasons while an active sensor array measurement is being performed.

4.1 Programming connector



1	MOSI	Int (PE5004)	2
3	MISO	SS	4
5	VDD 3,3V	SCL	6
7	GND	RST	8

Figure 3 – Bottom board side

4.2 Sensor connection

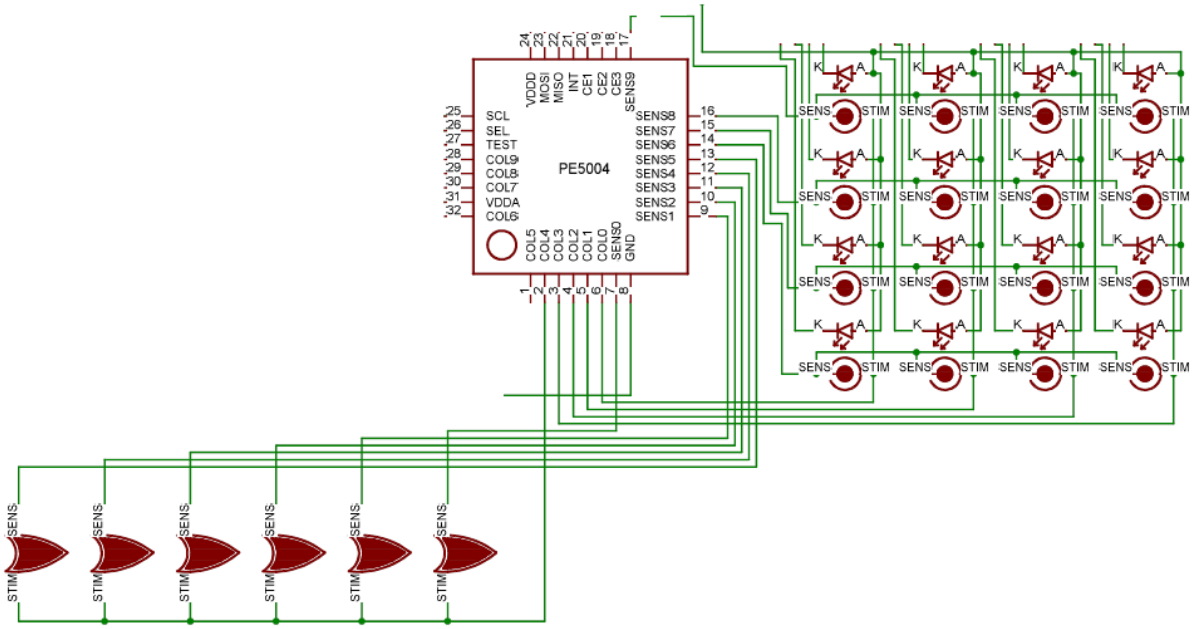


Figure 4 – Sensor connection

4.3 LED connection

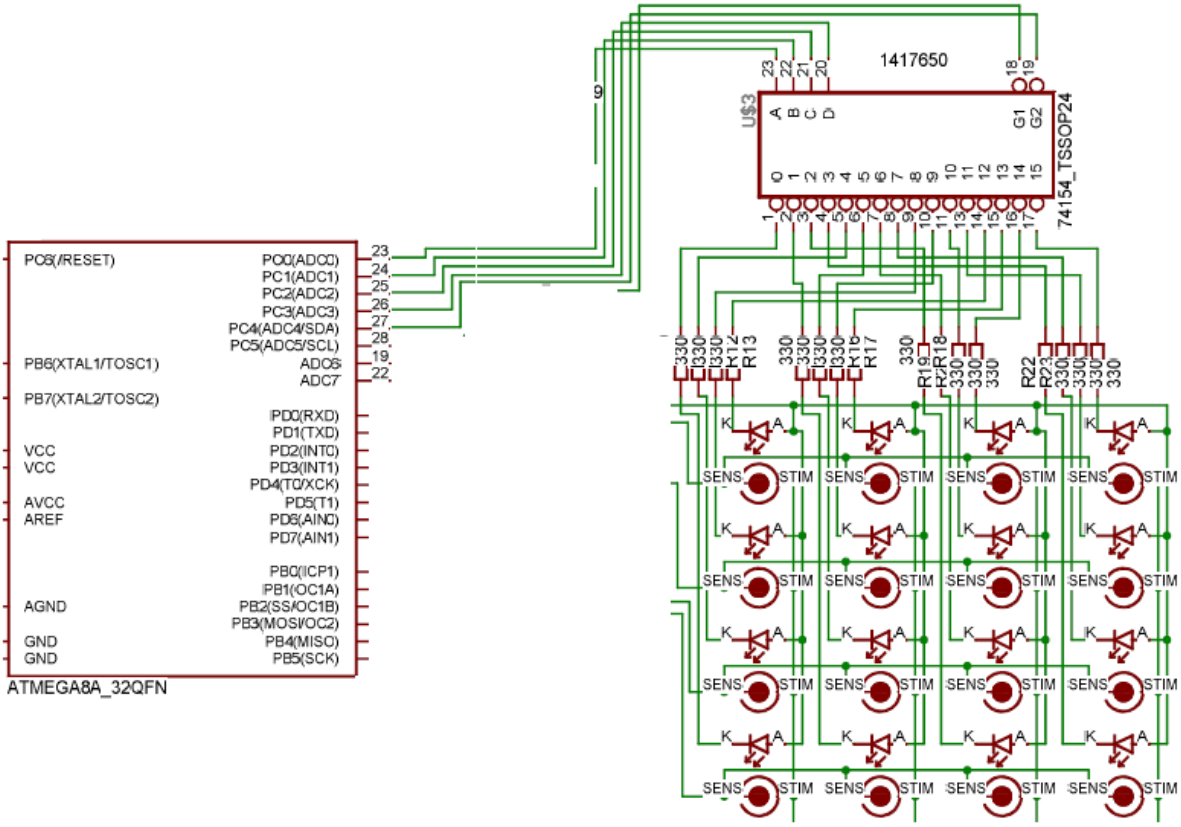


Figure 5 – LED connection

INPUTS						OUTPUTS									OUTPUTS						
$\overline{E0}$	$\overline{E1}$	A0	A1	A2	A3	$\overline{O0}$	$\overline{O1}$	$\overline{O2}$	$\overline{O3}$	$\overline{O4}$	$\overline{O5}$	$\overline{O6}$	$\overline{O7}$	$\overline{O8}$	$\overline{O9}$	$\overline{O10}$	$\overline{O11}$	$\overline{O12}$	$\overline{O13}$	$\overline{O14}$	$\overline{O15}$
L	H	X	X	X	X	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
H	L	X	X	X	X	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
H	H	X	X	X	X	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
L	L	L	L	L	L	L	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
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L	L	H	H	H	L	H	H	H	H	H	H	H	L	H	H	H	H	H	H	H	H
L	L	L	L	L	H	H	H	H	H	H	H	H	H	L	H	H	H	H	H	H	H
L	L	H	L	L	H	H	H	H	H	H	H	H	H	H	L	H	H	H	H	H	H
L	L	L	H	L	H	H	H	H	H	H	H	H	H	H	H	L	H	H	H	H	H
L	L	H	H	L	H	H	H	H	H	H	H	H	H	H	H	H	L	H	H	H	H
L	L	L	L	H	H	H	H	H	H	H	H	H	H	H	H	H	H	L	H	H	H
L	L	H	L	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	L	H	H
L	L	L	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	L	H
L	L	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H	L

H = High voltage level
L = Low voltage level
X = Don't care

Figure 6 – Function Table 1-of-16 decoder 74f154

4.4 7-SEG LED connection

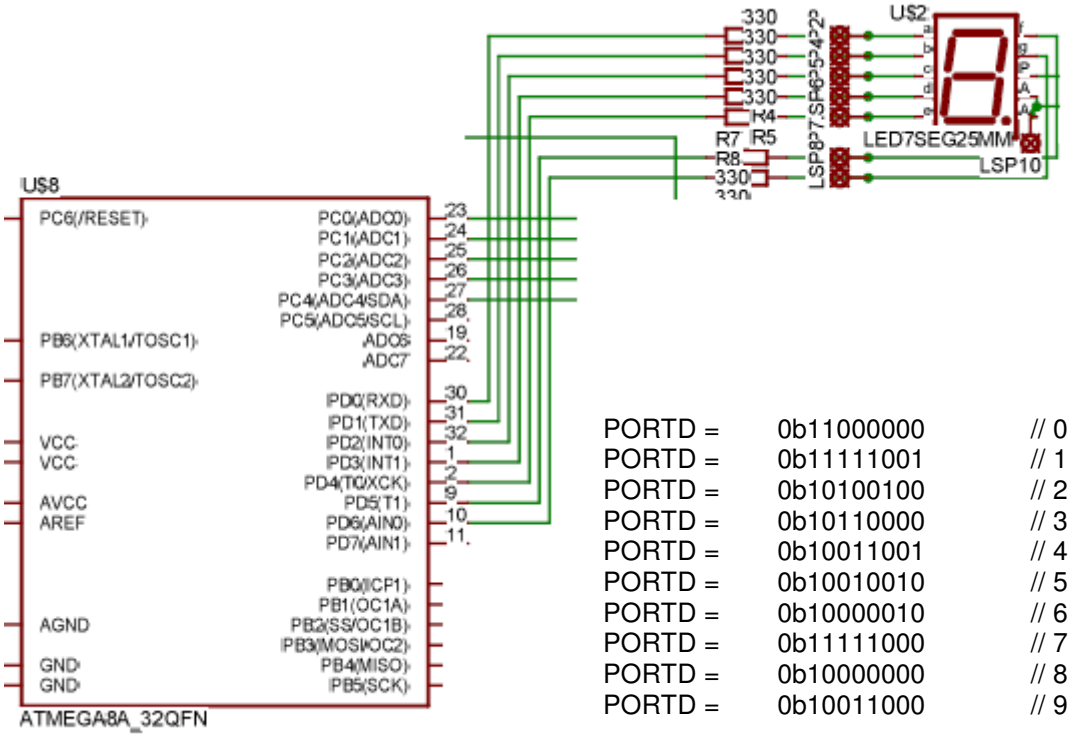

Figure 7 – 7-SEG LED connection and Port output

5 Notes

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Quality data are available on request.

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