

# Advanced touch sense control from Infineon – a technical introduction

July 2010



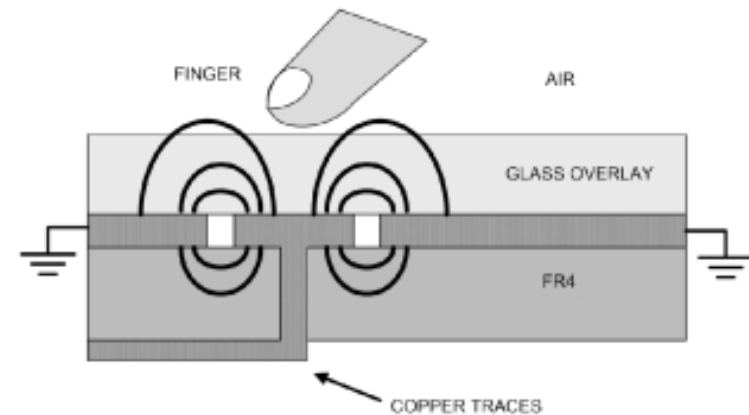
# Table of contents

- Generic benefits of Capacitive Touch Sensing
- The Relaxation Oscillator Topology
- Dedicated functional unit for Touch Sense and LED-Matrix control
- High current ports

# Generic benefits of Capacitive Touch Sensing



- Capacitive sensing is an attractive switch option
- At the heart of any capacitive-sensing system is a set of conductors which interact with electric fields. The human body varies the capacitance of this system
- The Touch Pad Controller measures the capacitance of these touch pads
- Benefits of Touch Sense Buttons
  - More reliable than mechanical counterpart – no wear out
  - Decreased bill of material
  - Best suited for flat control panels
  - Flexibility in touch pad design – button, slider, dial



# Table of contents

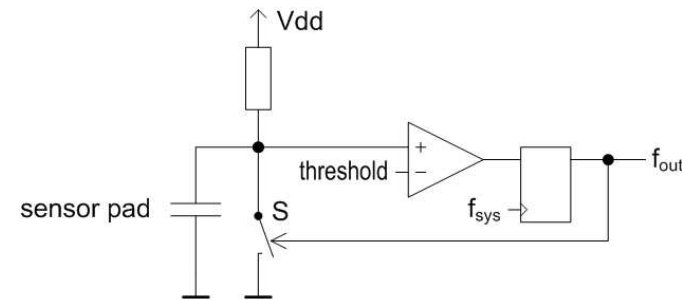
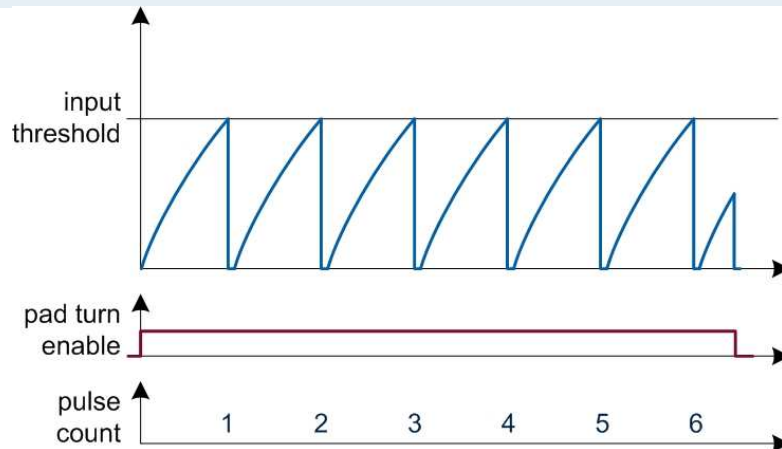
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# Capacitive Touch Sensing with the Relaxation Oscillator Topology



- Initially, the discharge switch is open, and the pull-up resistor charges the sensor pad.
- The voltage on the sensor pad ramps positively until it exceeds the comparator's threshold.
- The comparator's output transitions from low to high, causing the discharge switch *S* to close.
- The sensor pad quickly discharges through this low impedance path to ground.
- The process causes the comparator's output to transition from high to low, and the cycle repeats.
- The output frequency ( $f_{out}$ ) is dependent on the charging current and capacitive sensor value.

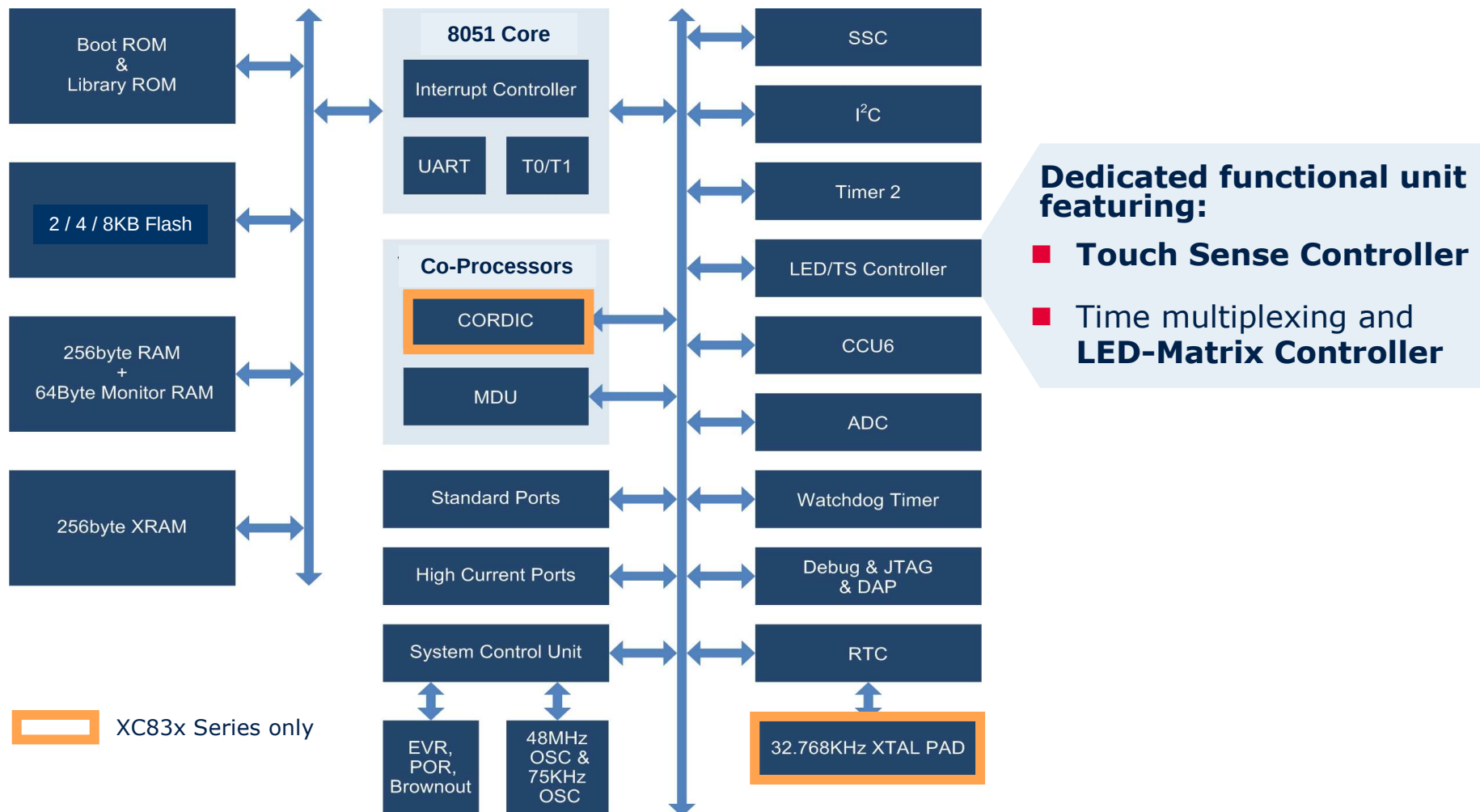
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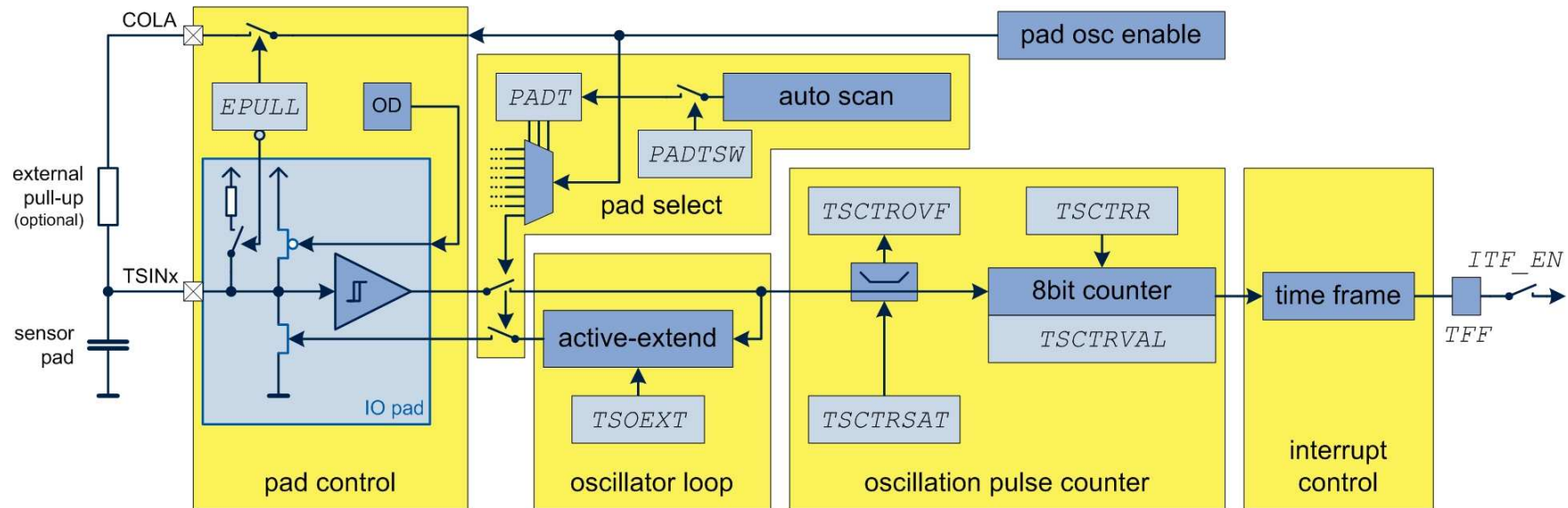
# A dedicated functional unit for advanced touch control



## Functional blocks of the XC82x and XC83x MCU Series supporting advanced touch sense control

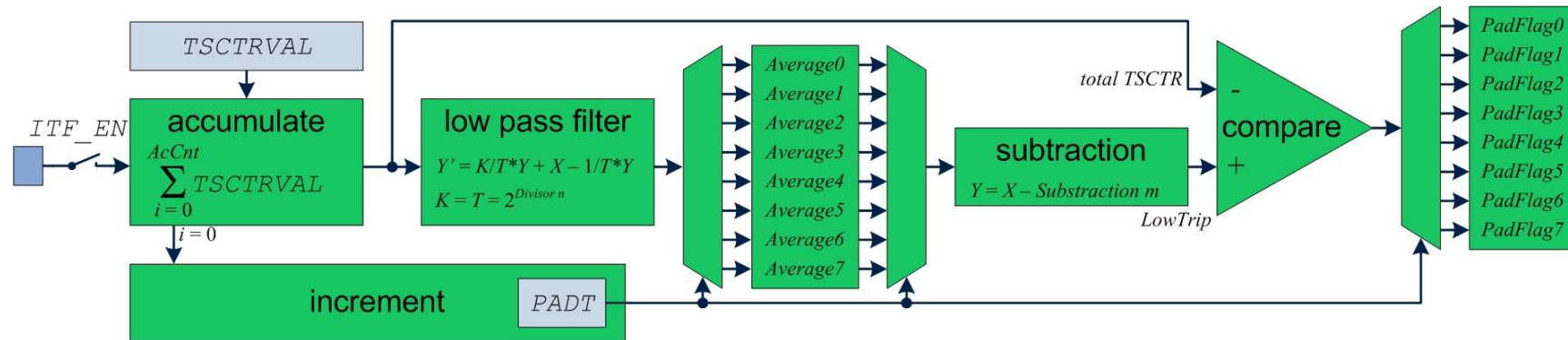


# Touch Sense Controller Features



- External or internal pull-up resistor
- Automatic pad select logic for auto scan function
- Adjustable discharge time
- Adjustable saturation/overflow behavior of oscillation pulse counter
- Counter value evaluation in interrupt service routine

# Touch Sense Controller Software in ROM Library



## ■ Touch Sense Signal Conditioning

□ Adjustable Accumulation

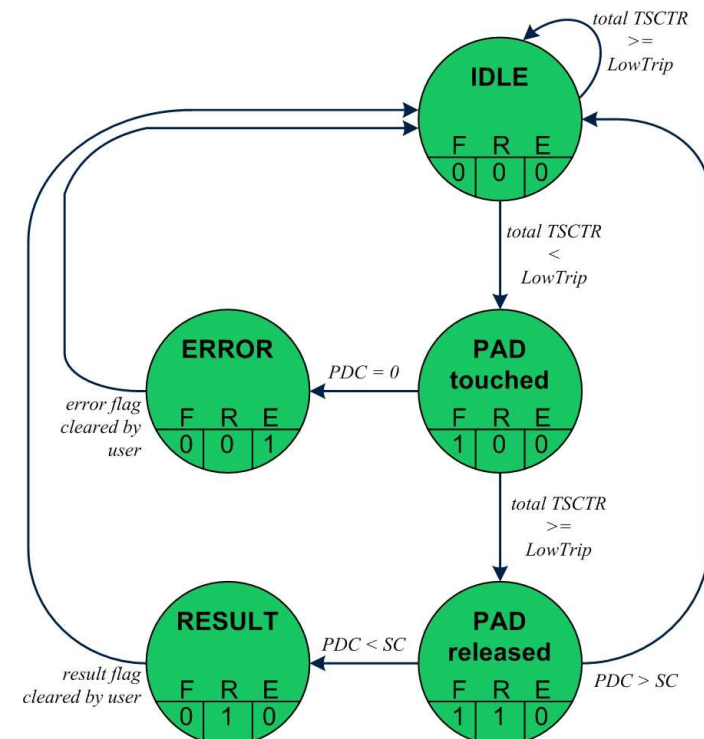
□ Glitch Filter

□ Adaptive Average Control

## ■ Touch Sense State Machine

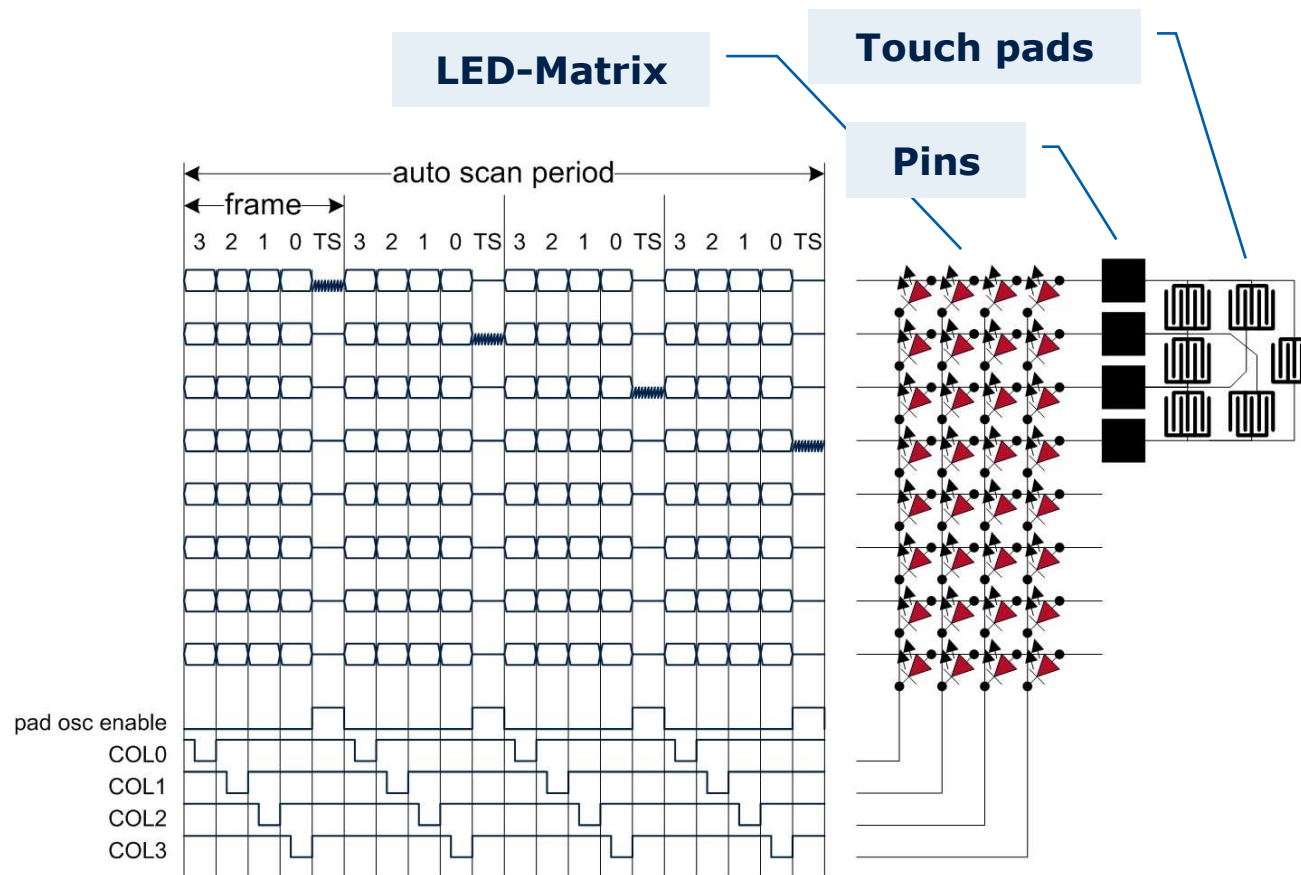
□ Pad-Down and Pad-Up Handling

□ Result and Error Handling



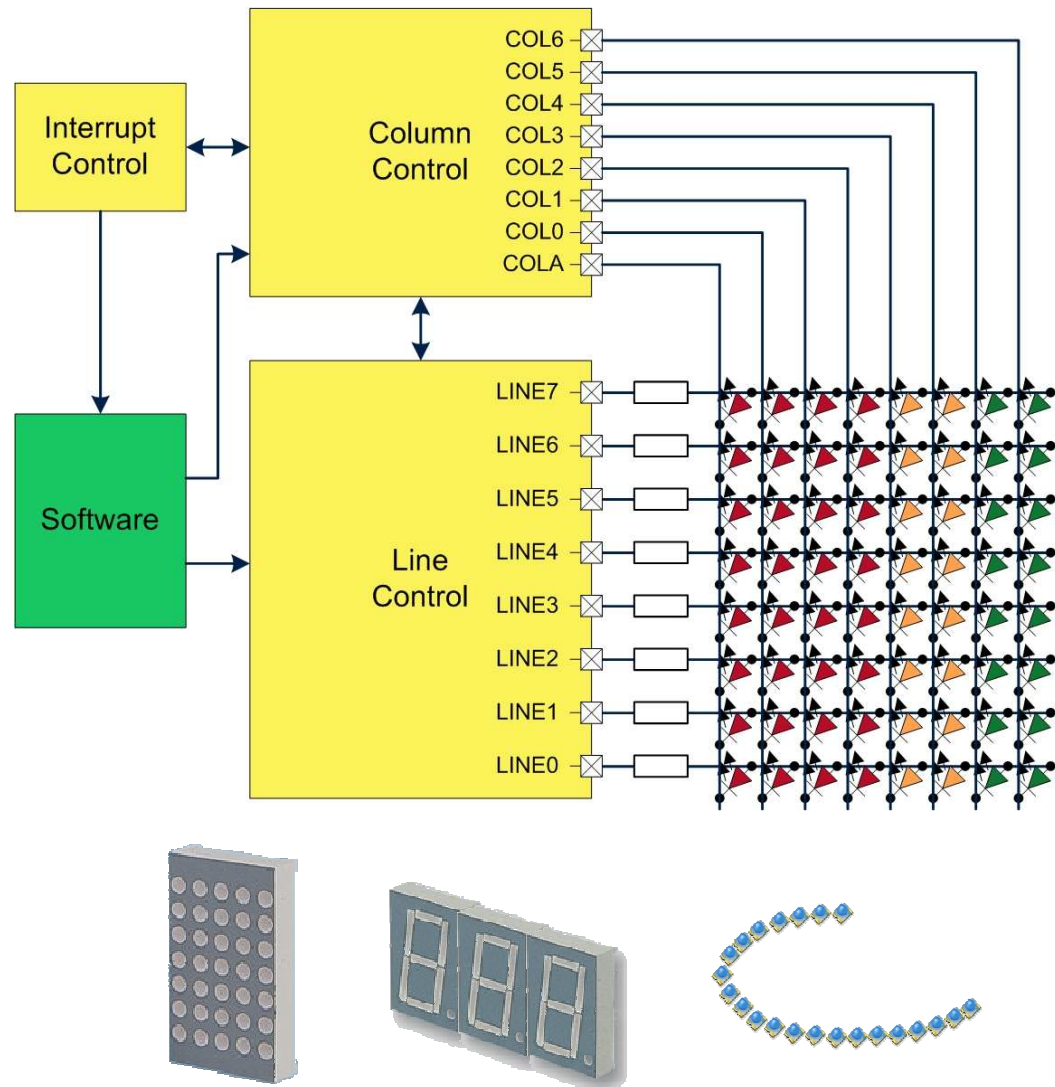
# Time multiplexed operation of touch sensing and LED-Matrix control

## Timing diagram for time multiplexed operation of touch sensing and LED-Matrix



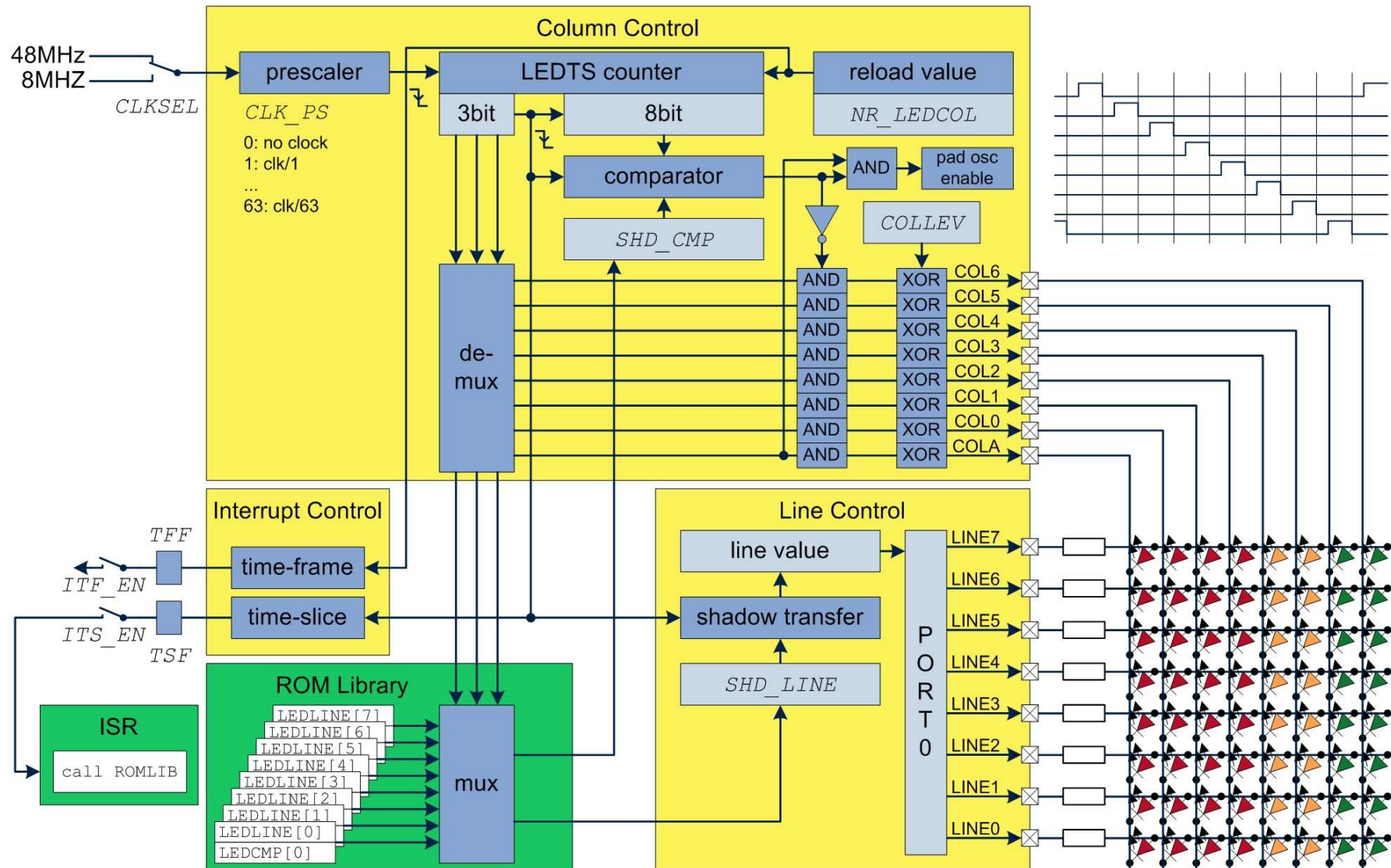
- LED-Matrix Controller and Touch Sense Controller can share the same pins
- The time multiplexed operation is controlled by the LED and Touch Sense Unit

# LED-Matrix Controller Overview



- An LED-Matrix consists of many LEDs which are arranged in lines and columns.
- A resistor in the line path limits the current
- The columns are activated one after another (multiplexing)
- The line signals must be synchronized to the column activation
- The LEDs can be arranged in various layouts

# LED-Matrix Controller Details



# ROM Libraries

## LED-Matrix and Touch Sense

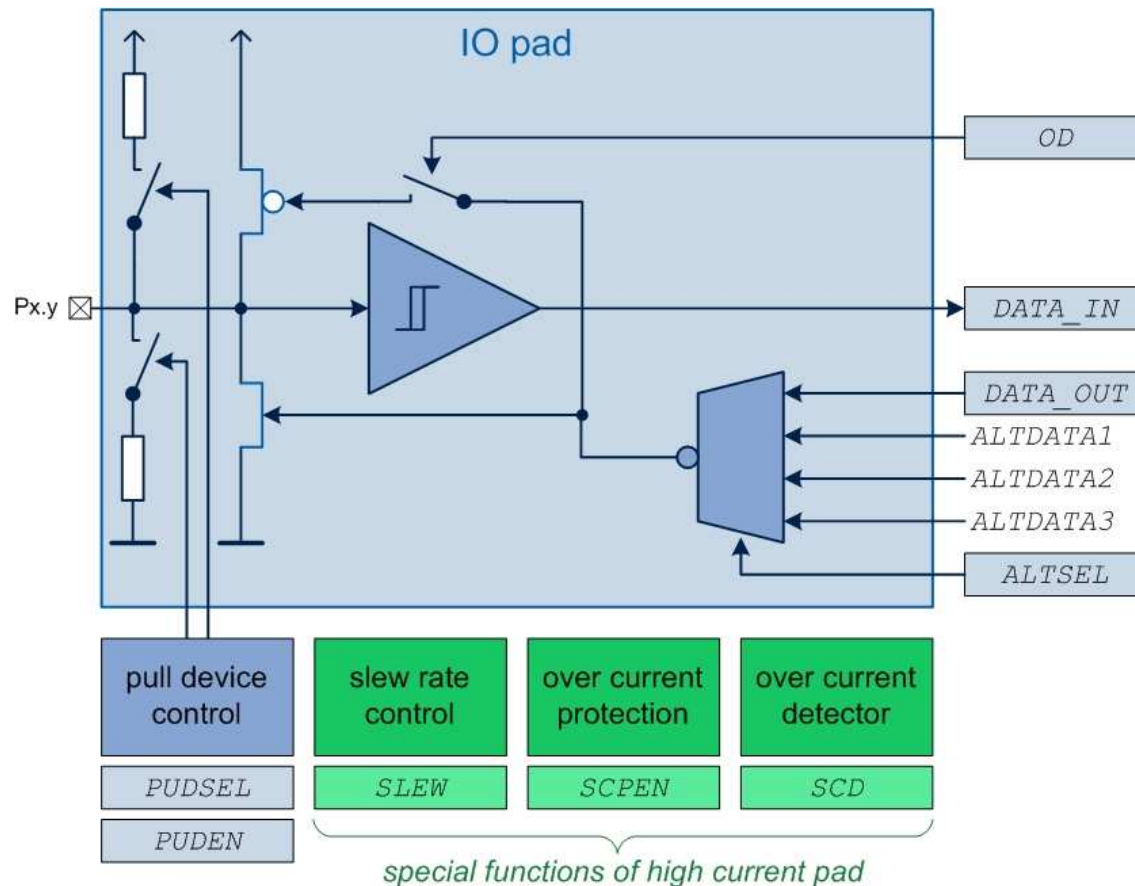


- The LED-Matrix and Touch Sense Library is the software counterpart for LED/TS hardware unit
- LED-Matrix supports up to 8x8 LEDs
- Touch Sense Evaluation Support
  - Glitch Filter
  - Adaptive Average Control
  - Pad-Down and Pad-Up Handling
  - Result and Error Handling
- Easy to use library functions will be called in interrupt service routines of LED/TS unit

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# High current ports up to 50 mA



## ■ P1.0...P1.3

- direct drive of stepper gauges 30mA
- Sink current up to 50mA
- over current detection
- slew rate control for optimized EMC behavior

## ■ P1.4...P1.5

- Sink current up to 50mA



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