

Introduction TP1

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TP1: Structure

We will go through the following steps:

- Understanding some basic features of the compiler;
- Writing a first LED blinking program, first with *NOP* loops, then using timers;
- Change the LED's blinking sequence using the selector.

Documentation

The goal of the practicals is **also** to train you to find the information to resolve issues linked with embedded systems, electronics and programming by yourselves, using for instance the documentations of the microcontroller.

STM 32 Datasheet

Regroup the technical data of the microcontroller


life.augmented

STM32F405xx
STM32F407xx

ARM Cortex-M4 32b MCU+FPU, 210DMIPS, up to 1MB Flash/192+4KB RAM, USB OTG HS/FS, Ethernet, 17 TIMs, 3 ADCs, 15 comm. interfaces & camera

Datasheet - production data

Features

- Core: ARM® 32-bit Cortex®-M4 CPU with FPU, Adaptive real-time accelerator (ART Accelerator™) allowing 0-wait state execution from Flash memory, frequency up to 168 MHz, memory protection unit, 210 DMIPS/1.25 DMIPS/MHz (Dhrystone 2.1), and DSP instructions
- Memories
 - Up to 1 Mbyte of Flash memory
 - Up to 192+4 Kbytes of SRAM including 64-Kbyte of CCM (core coupled memory) data RAM
- Flexible static memory controller supporting Compact Flash, SRAM, PSRAM, NOR and NAND memories
- LCD parallel interface, 8080/6800 modes
- Clock, reset and supply management
 - 1.8 V to 3.6 V application supply and I/Os
 - POR, PDR, PVD and BOR
 - 4-to-26 MHz crystal oscillator
 - Internal 16 MHz factory-trimmed RC (1% accuracy)
 - 32 kHz oscillator for RTC with calibration
 - Internal 32 kHz RC with calibration
- Low-power operation
 - Sleep, Stop and Standby modes
 - V_{BAT} supply for RTC, 20×32 bit backup registers + optional 4 KB backup SRAM
- 3×12-bit, 2.4 MSPS A/D converters: up to 24 channels and 7.2 MSPS in triple interleaved mode
- 2×12-bit D/A converters
- General-purpose DMA: 16-stream DMA controller with FIFOs and burst support



LQFP64 (10 × 10 mm)
LQFP100 (14 × 14 mm)
LQFP144 (20 × 20 mm)
LQFP176 (24 × 24 mm)

WL-CSP90 (4.223×3.969 mm)

UFBGA176 (10 × 10 mm)

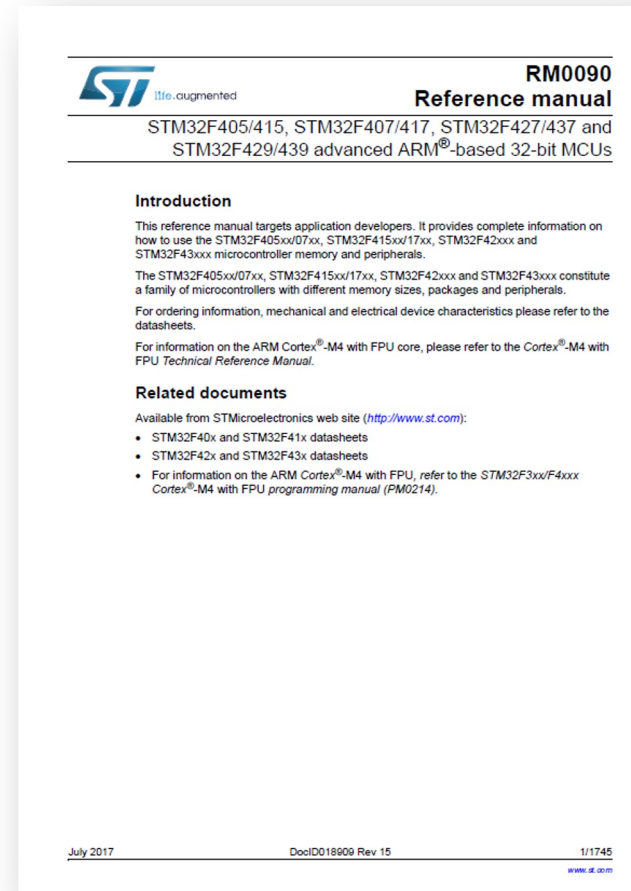
- Up to 17 timers: up to twelve 16-bit and two 32-bit timers up to 168 MHz, each with up to 4 IC/OC/PWM or pulse counter and quadrature (incremental) encoder input
- Debug mode
 - Serial wire debug (SWD) & JTAG interfaces
 - Cortex-M4 Embedded Trace Macrocell™
- Up to 140 I/O ports with interrupt capability
 - Up to 136 fast I/Os up to 84 MHz
 - Up to 138 5 V-tolerant I/Os
- Up to 15 communication interfaces
 - Up to 3 × I²C interfaces (SMBus/PMBus)
 - Up to 4 USARTs/2 UARTs (10.5 Mbit/s, ISO 7816 interface, LIN, IrDA, modem control)
 - Up to 3 SPIs (42 Mbit/s), 2 with muxed full-duplex I²S to achieve audio class accuracy via internal audio PLL or external clock
 - 2 × CAN interfaces (2.0B Active)
 - SDIO interface
- Advanced connectivity
 - USB 2.0 full-speed device/host/OTG controller with on-chip PHY
 - USB 2.0 high-speed/full-speed device/host/OTG controller with dedicated DMA, on-chip full-speed PHY and ULPI
 - 10/100 Ethernet MAC with dedicated DMA: supports IEEE 1588v2 hardware, MII/RMII

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This is information on a product in full production. www.st.com

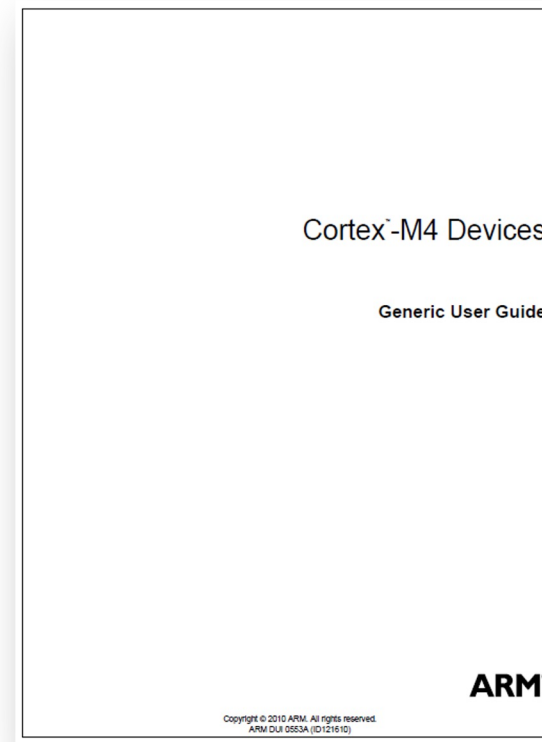
STM 32 Reference Manual

Application and
programming
(memory, registers,
peripherals) of the
microcontroller

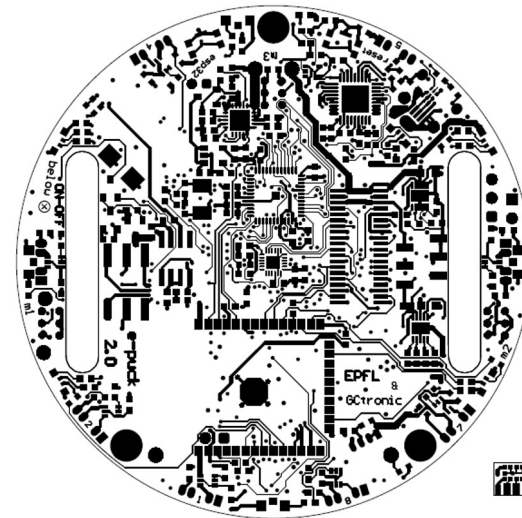
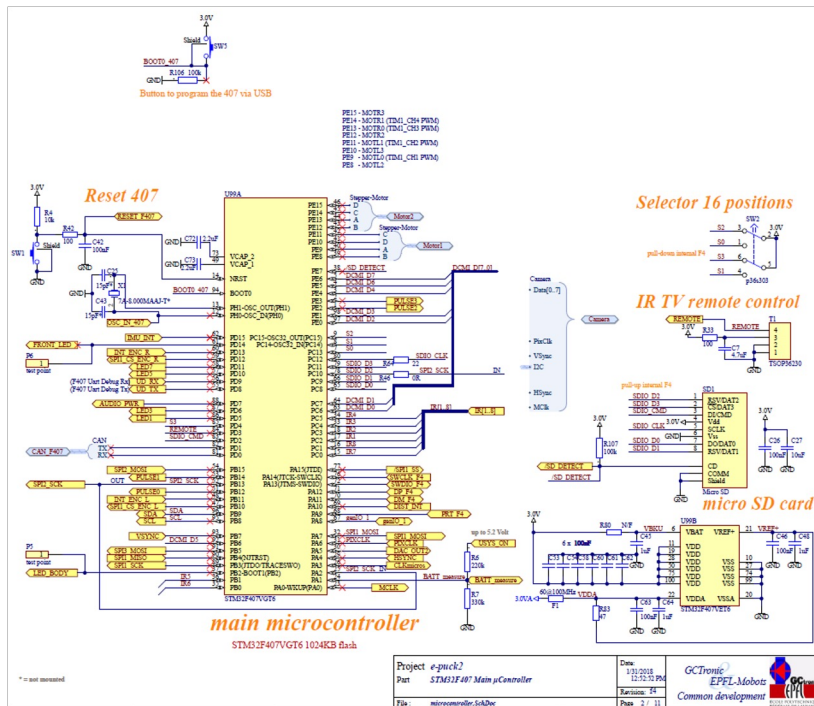


Cortex-M4 Generic User Guide

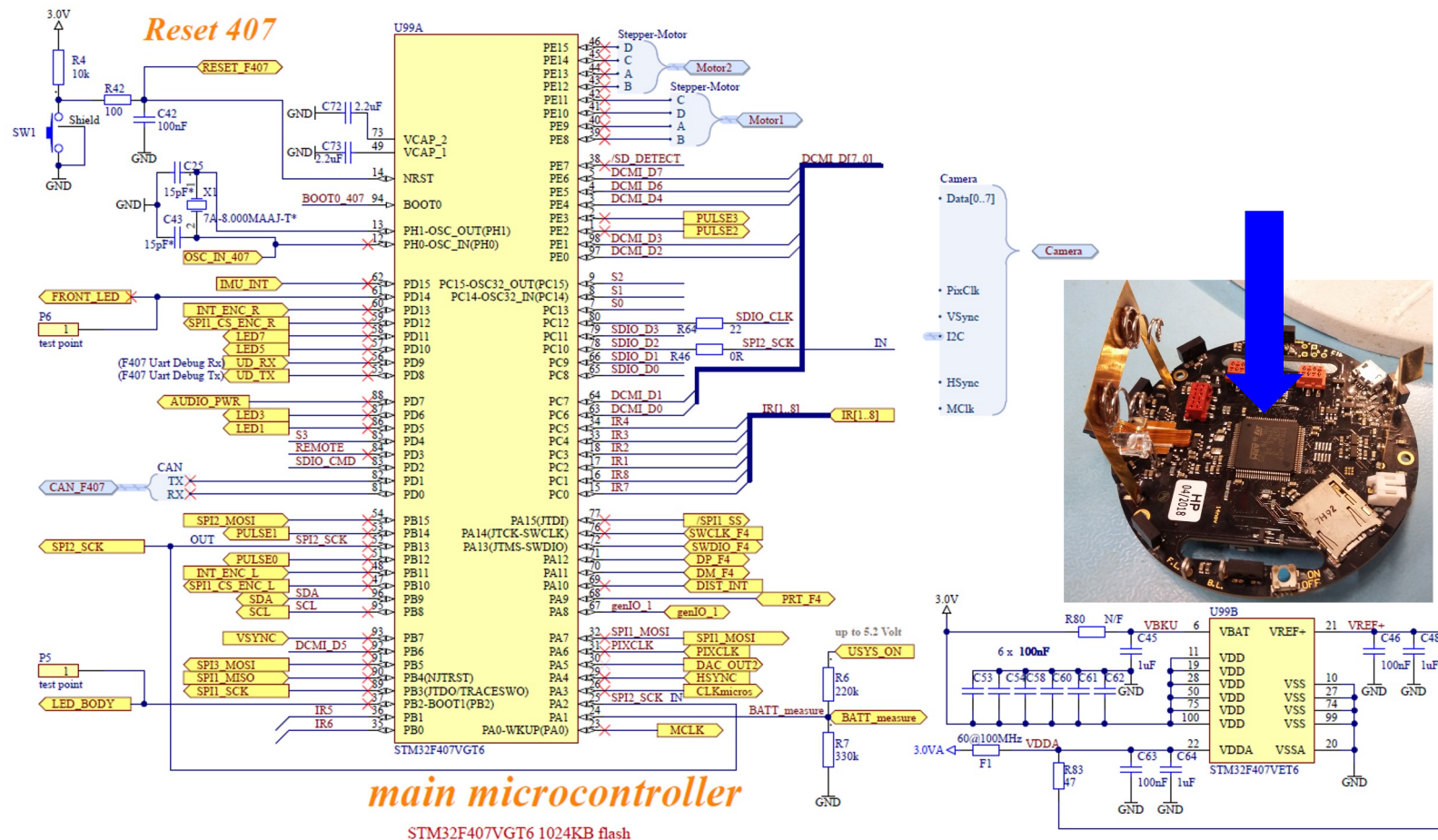
Architecture of the
ARM processor,
programming of the
processor (registers,
assembly instructions)



Dossier Electronique

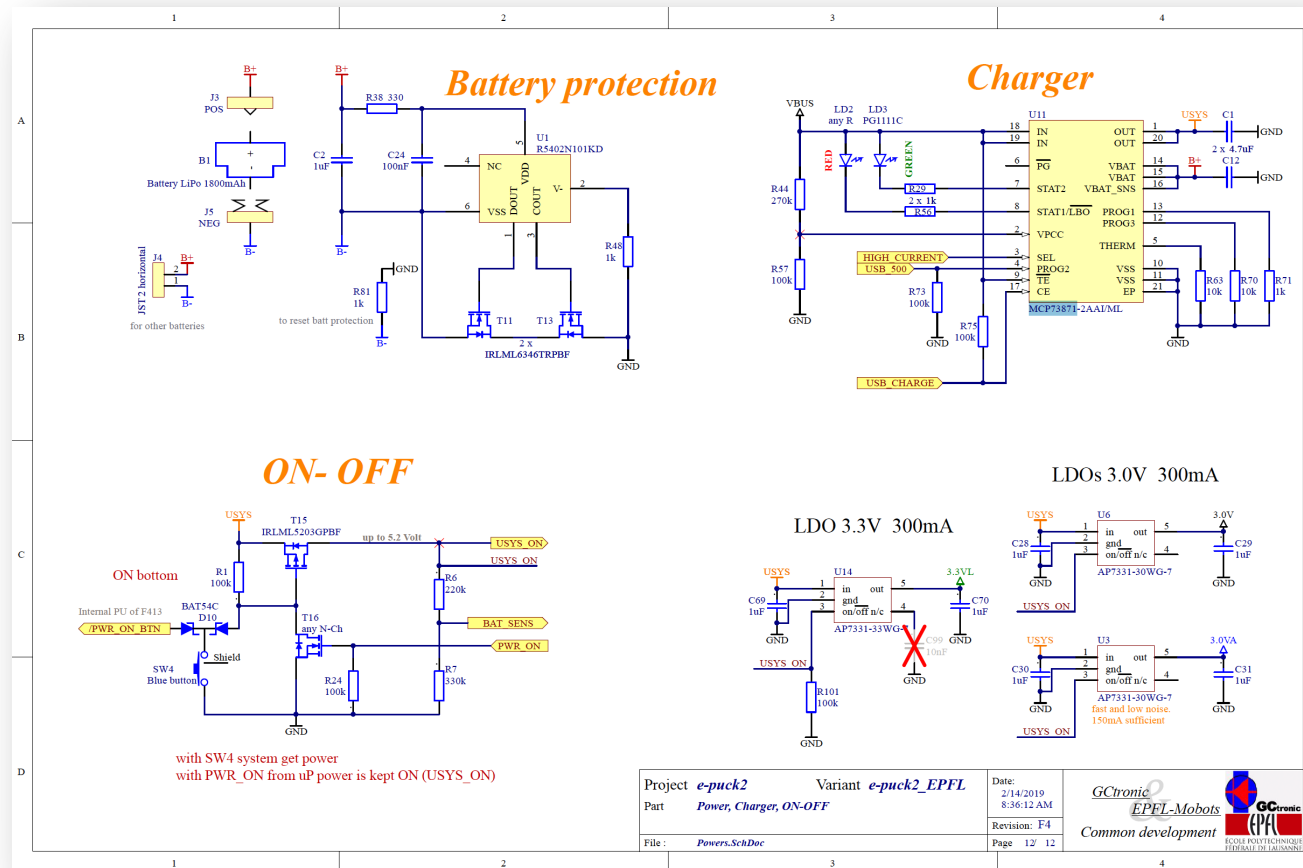


Schematics: Microcontroller

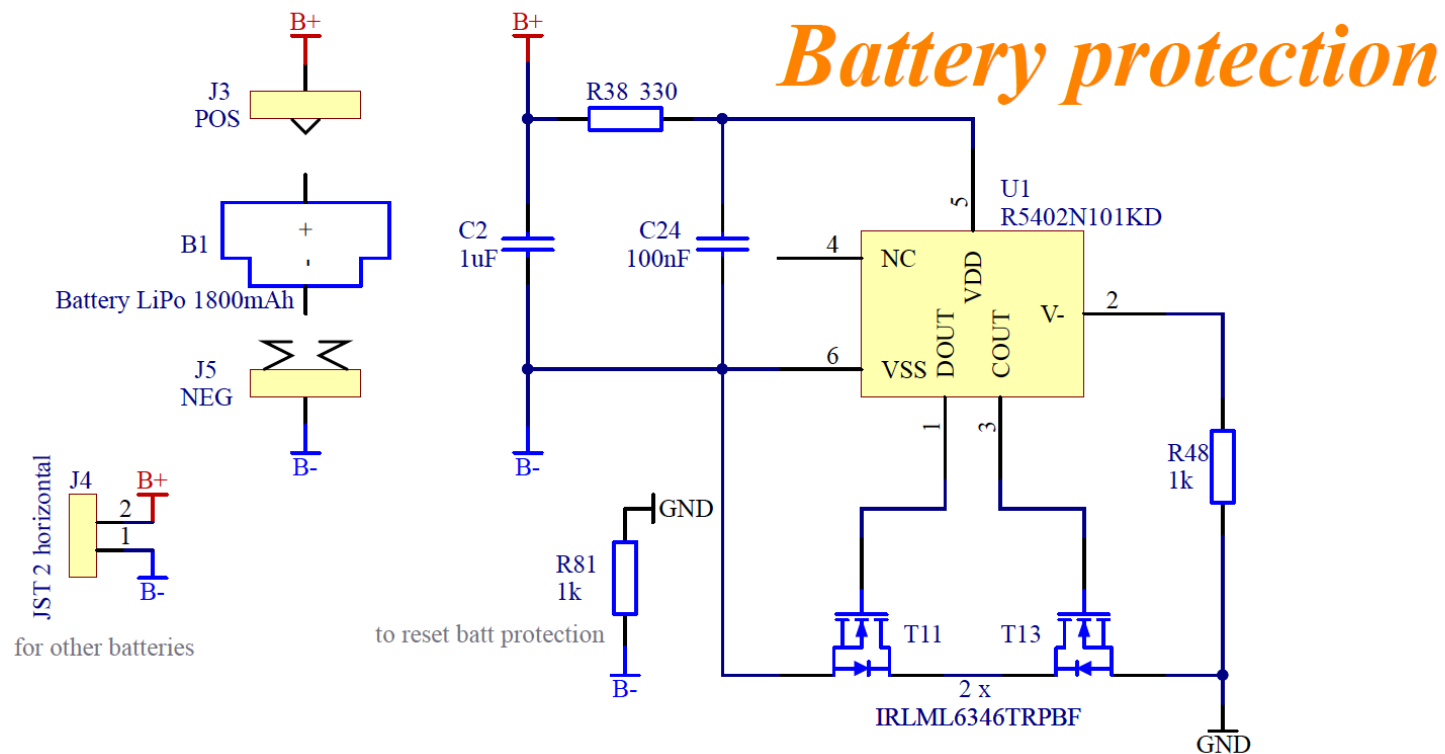




Schematics: Power supply

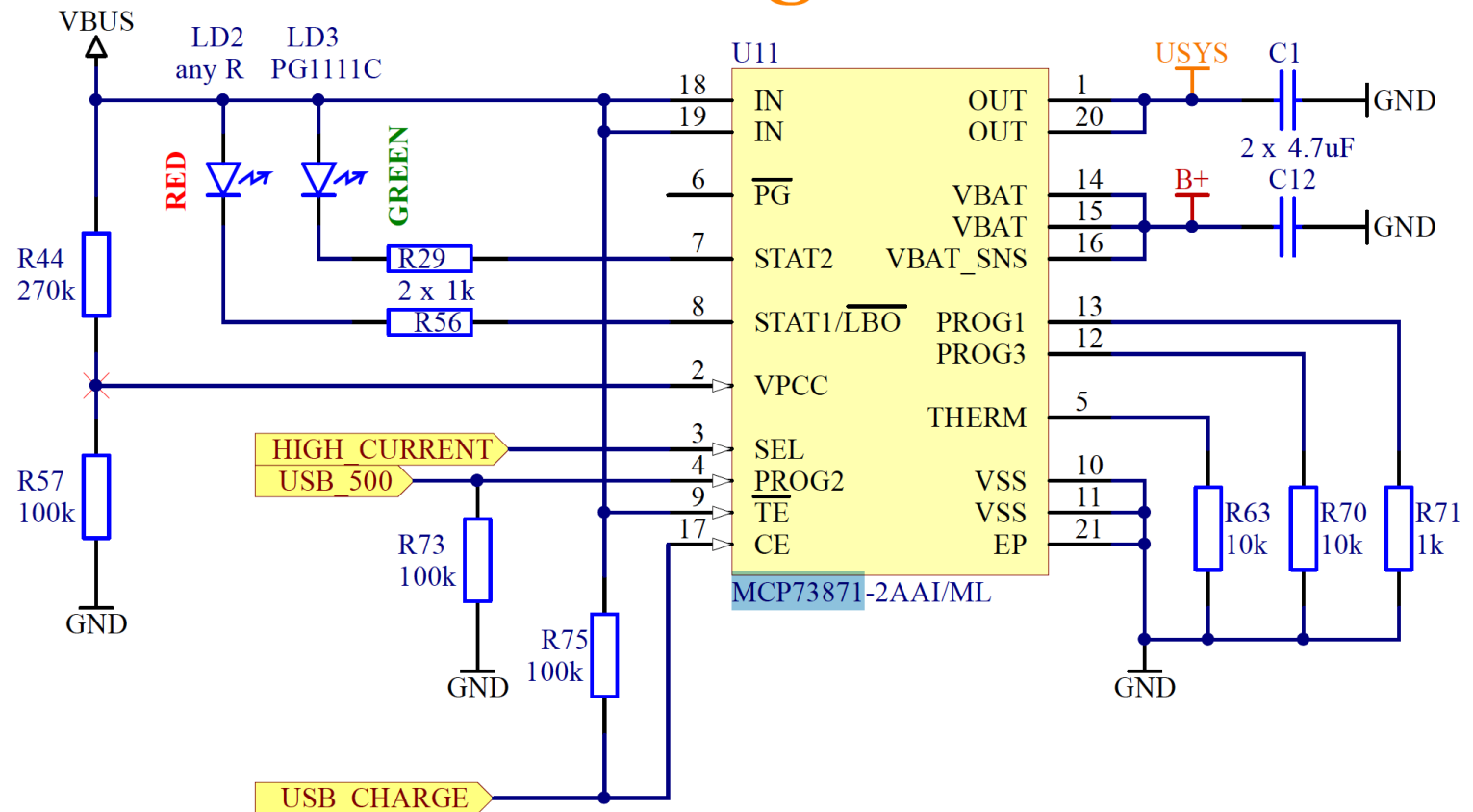


Schematics: Power supply



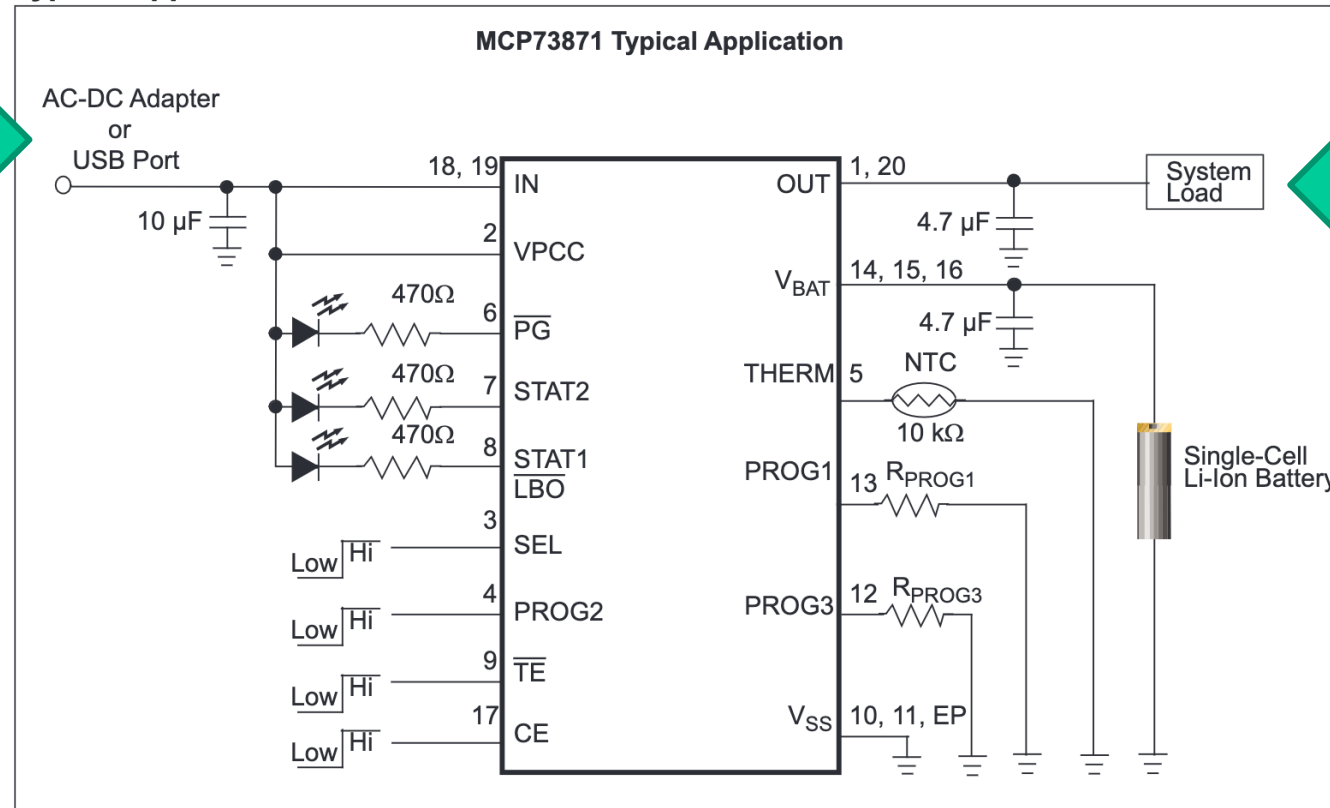
Schematics:

Charger



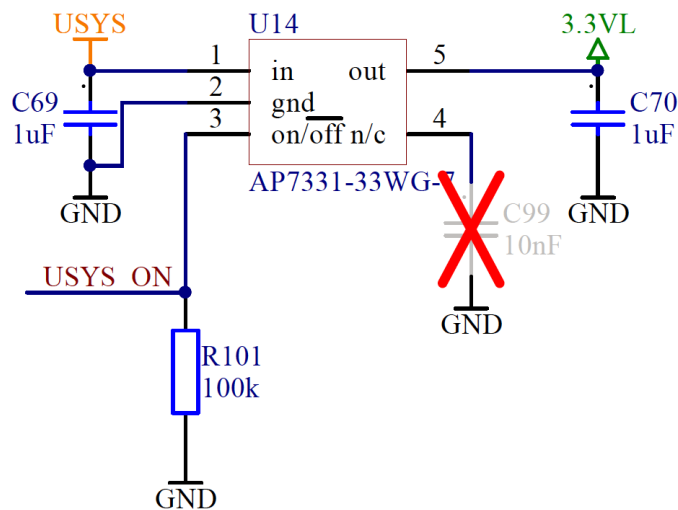
Schematics: Power supply

Typical Application Circuit

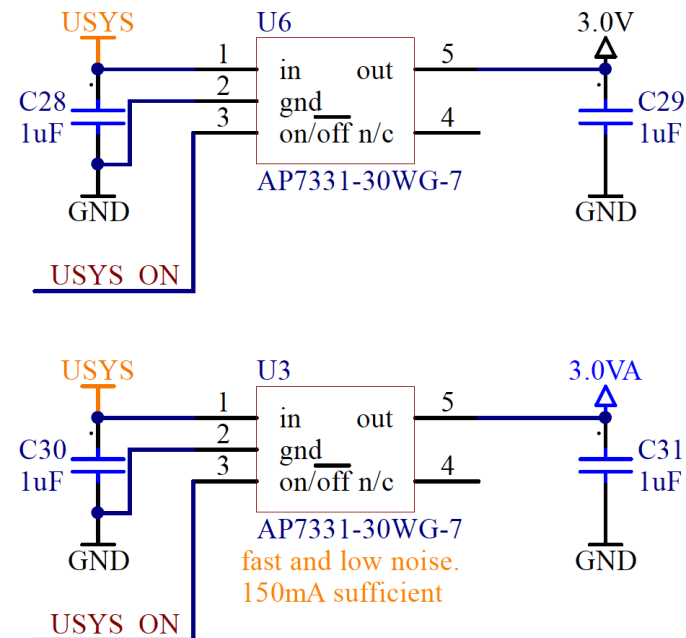


Schematics: Power supply

LDO 3.3V 300mA

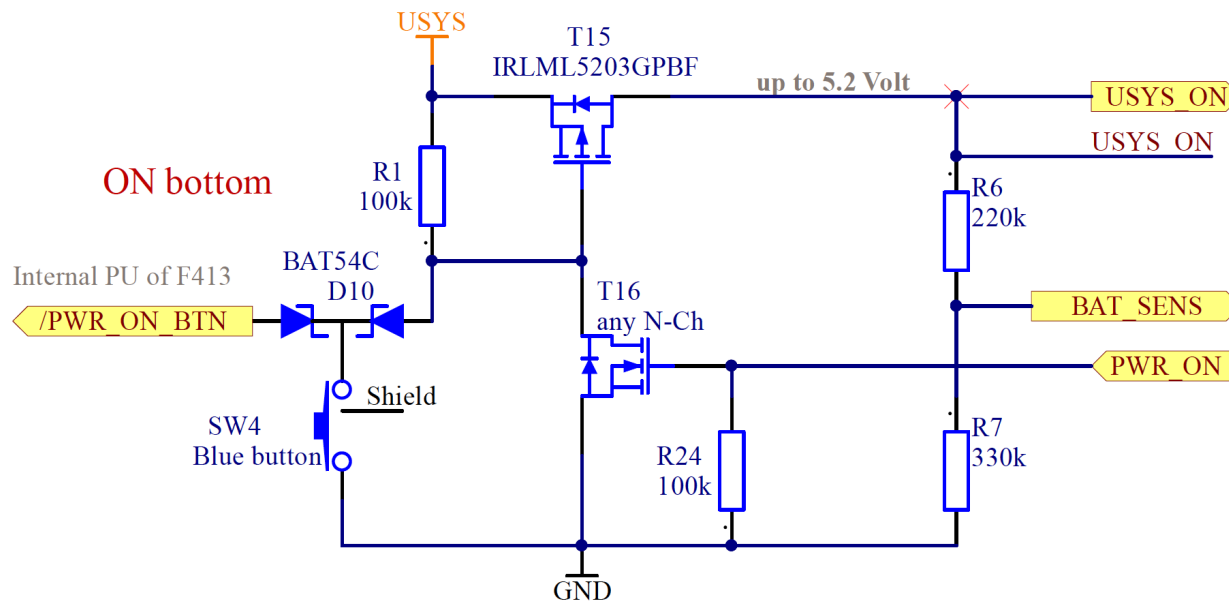


LDOs 3.0V 300mA



Schematics: Power supply

ON- OFF

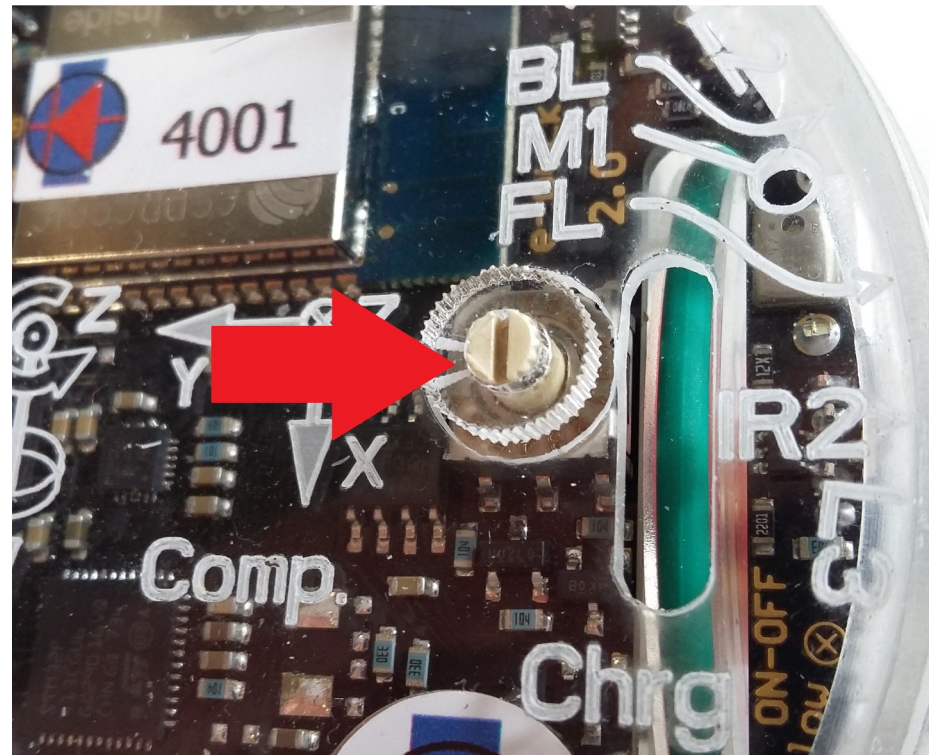
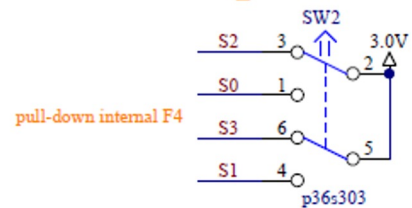


with SW4 system get power

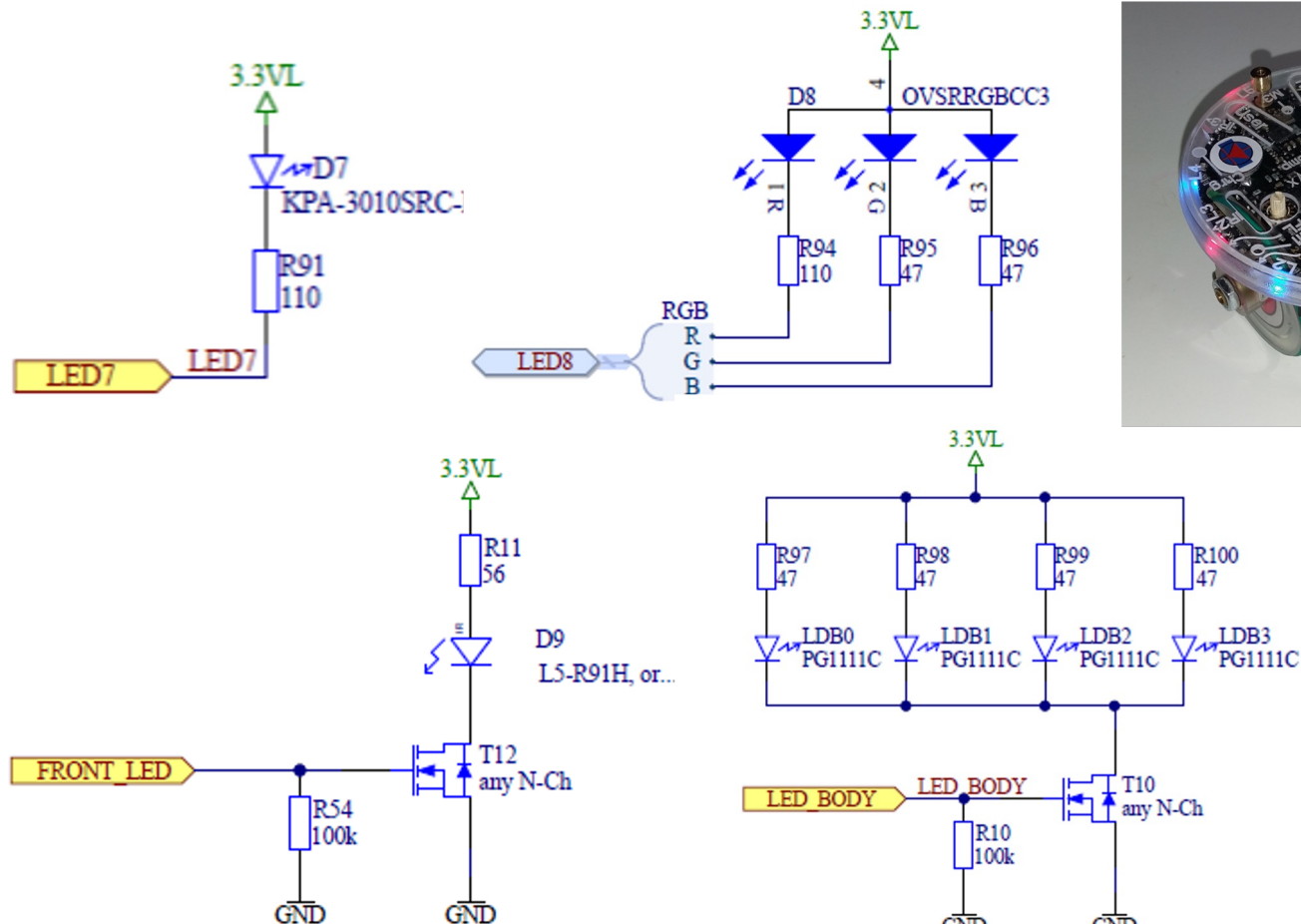
with PWR_ON from uP power is kept ON (USYS_ON)

Schematics: Selector

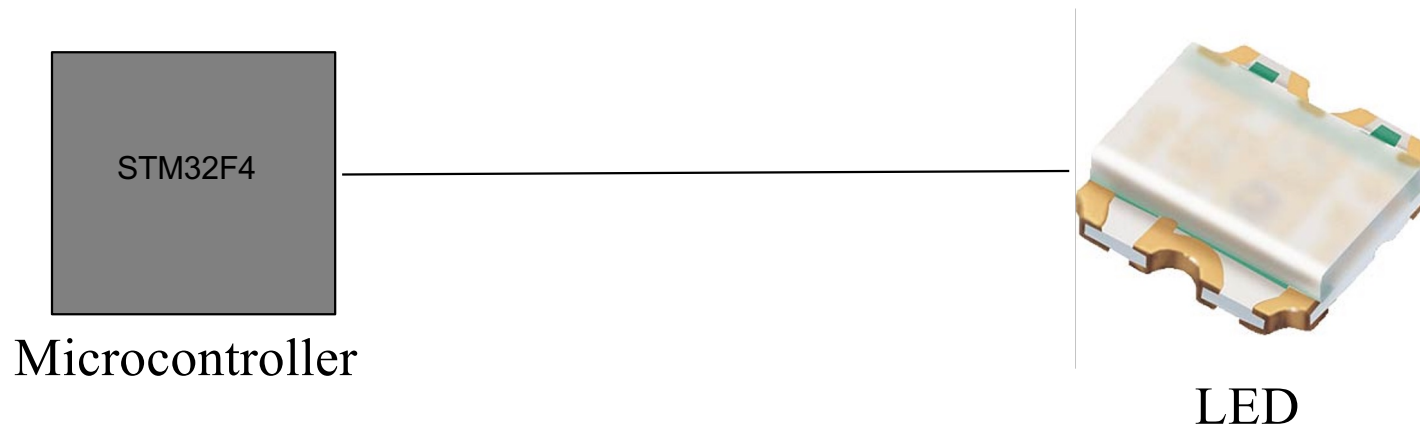
Selector 16 positions



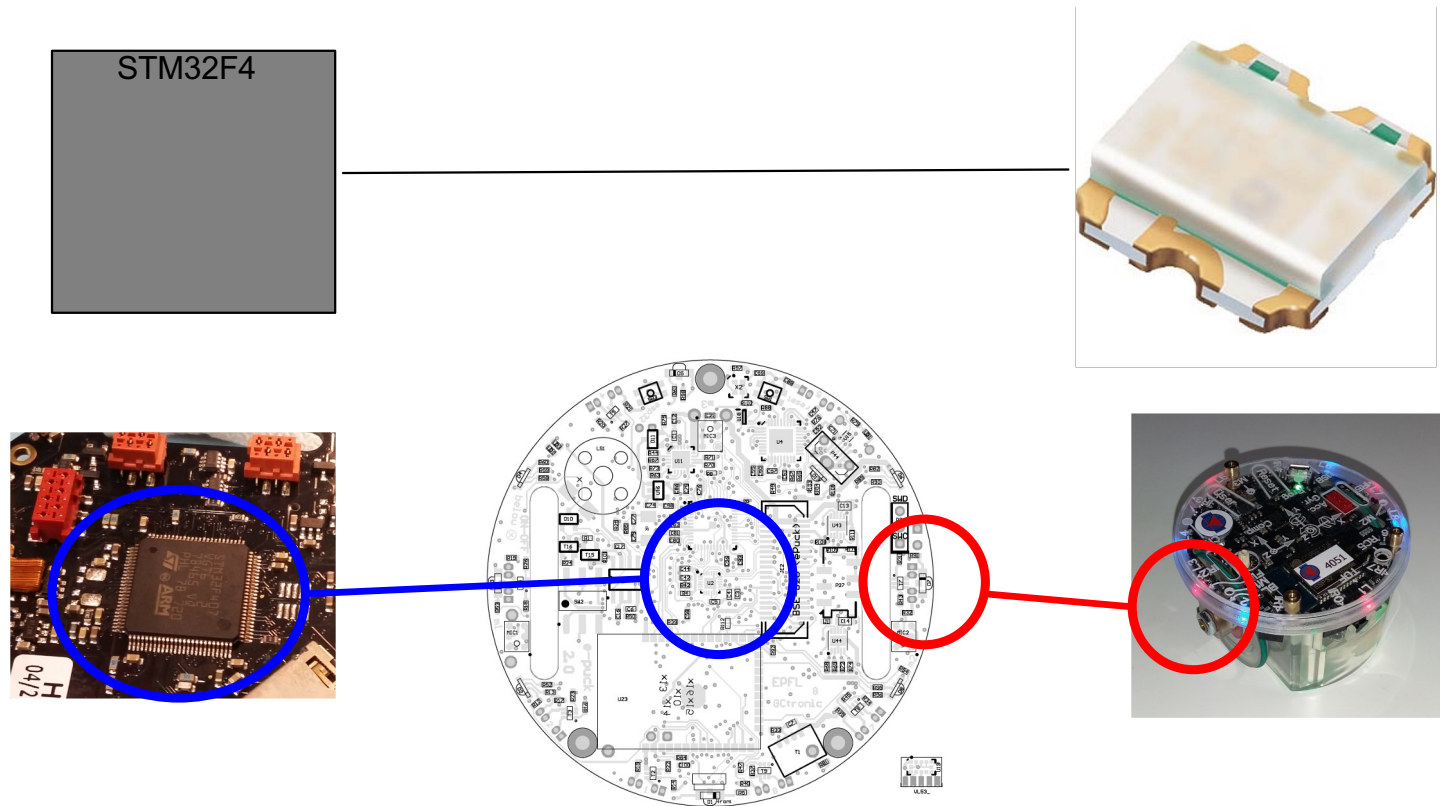
Schematics: LEDs (different types)



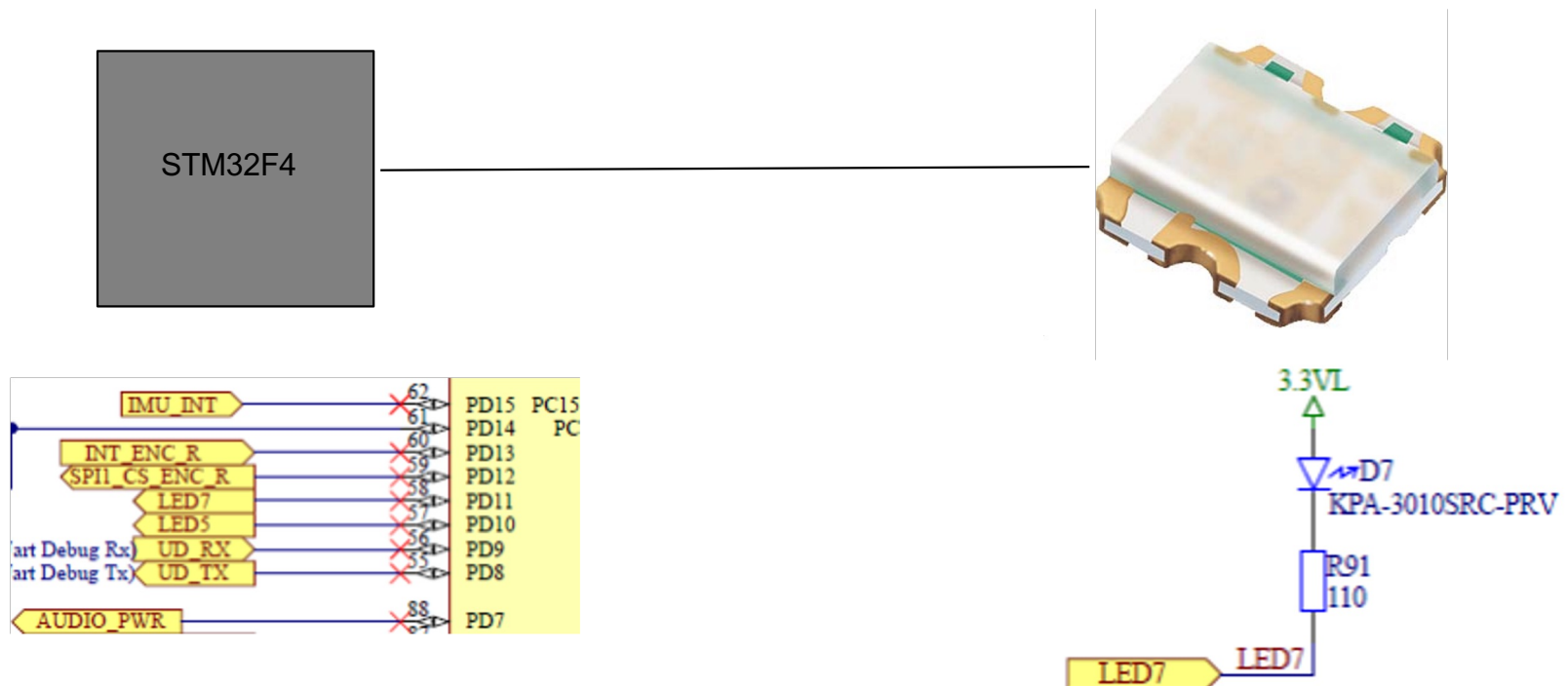
Interface



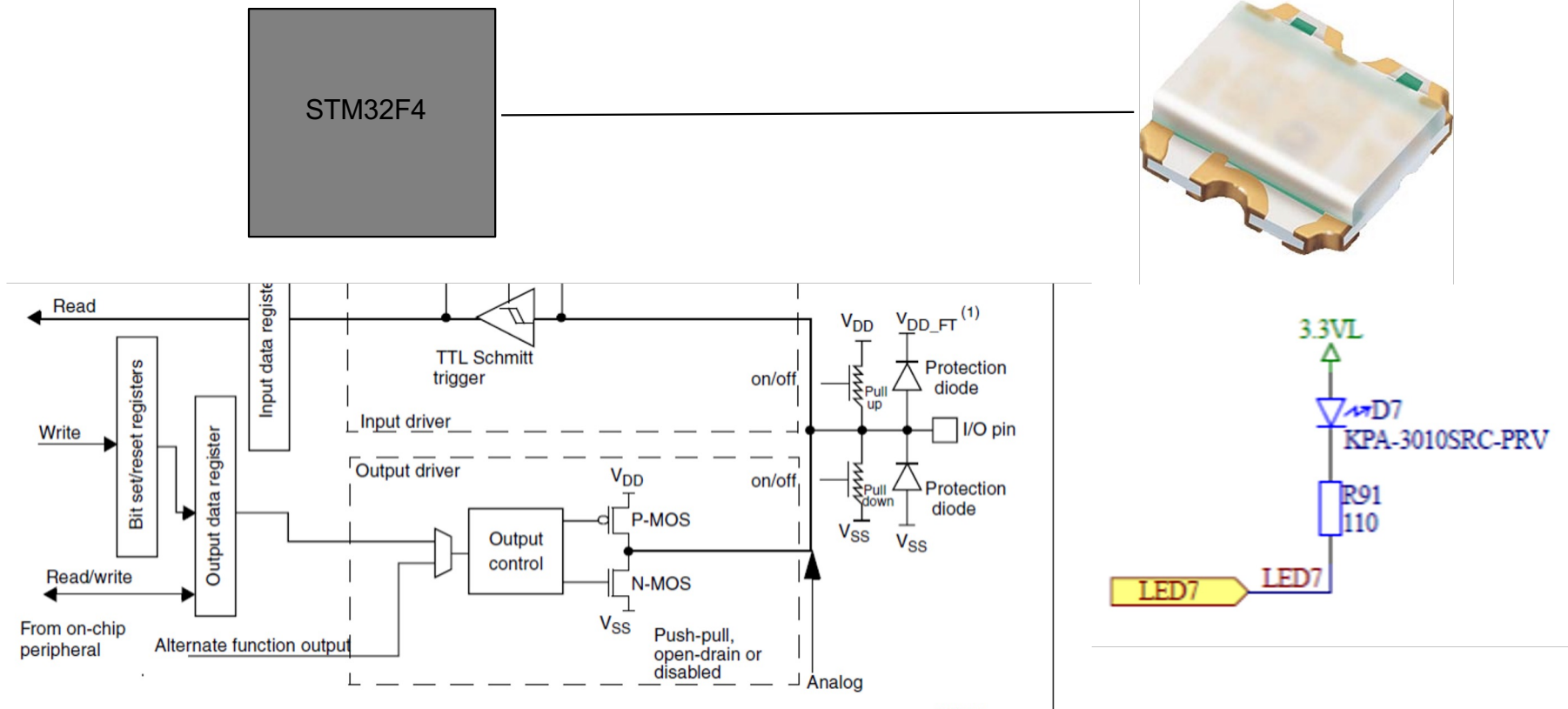
Interface: physical



Interface: schematics

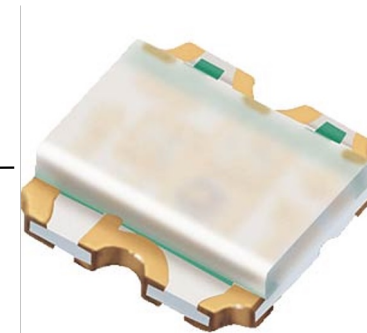


Interface: microcontroller / hardware

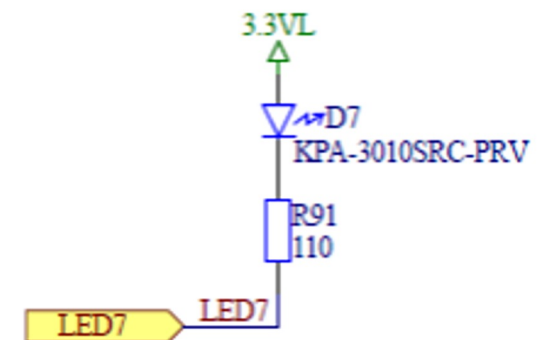


Interface: microcontroller / firmware

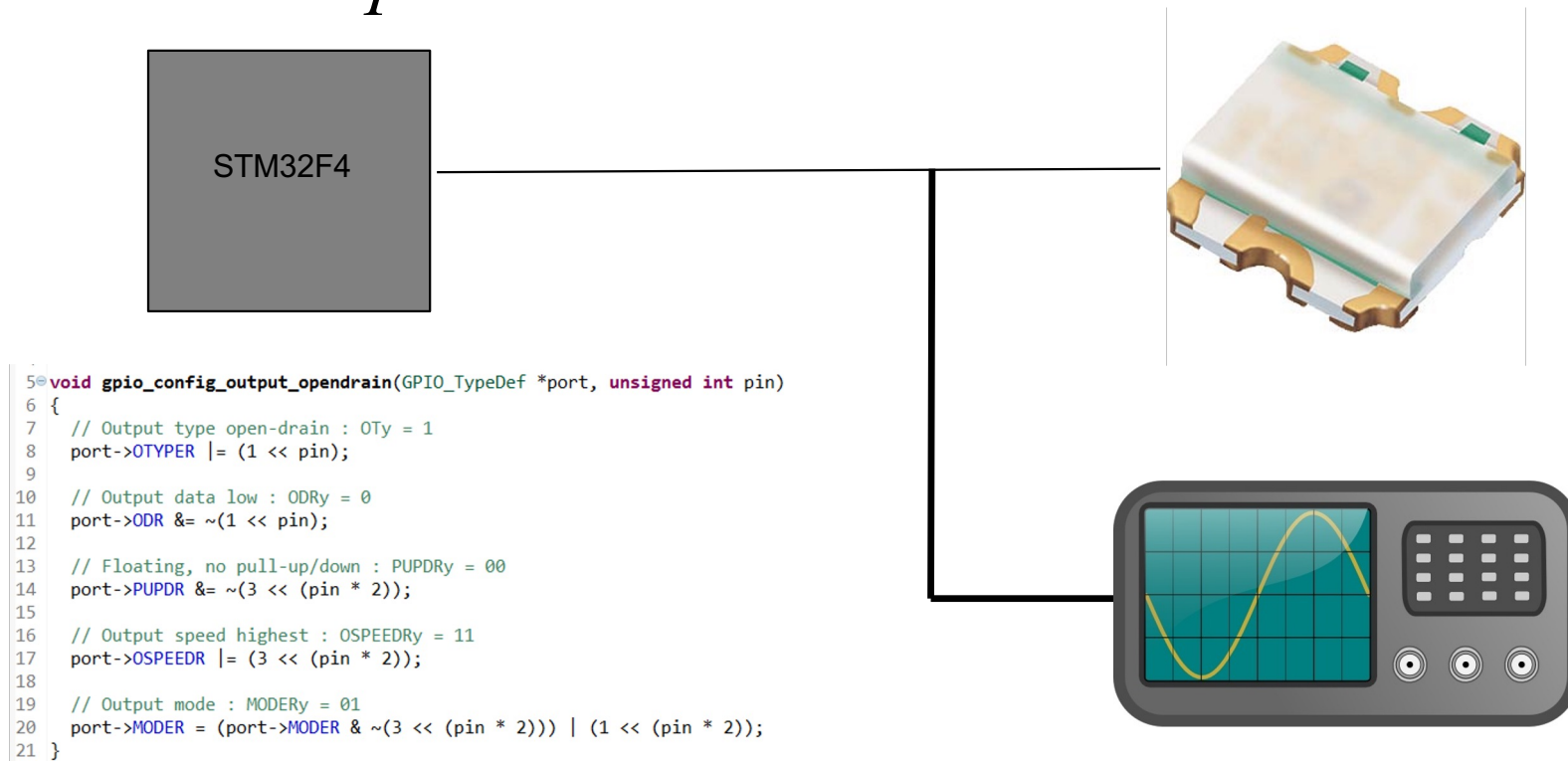
STM32F4



```
5 void gpio_config_output_opendrain(GPIO_TypeDef *port, unsigned int pin)
6 {
7     // Output type open-drain : OTy = 1
8     port->OTYPER |= (1 << pin);
9
10    // Output data low : ODRy = 0
11    port->ODR &= ~(1 << pin);
12
13    // Floating, no pull-up/down : PUPDRy = 00
14    port->PUPDR &= ~(3 << (pin * 2));
15
16    // Output speed highest : OSPEEDRy = 11
17    port->OSPEEDR |= (3 << (pin * 2));
18
19    // Output mode : MODERy = 01
20    port->MODER = (port->MODER & ~(3 << (pin * 2))) | (1 << (pin * 2));
21 }
```



Tools: Oscilloscope



Tools: NOP versus TIMER



NOP

versus



TIMER

Enjoy TP1!