



I .. V Jahrgang

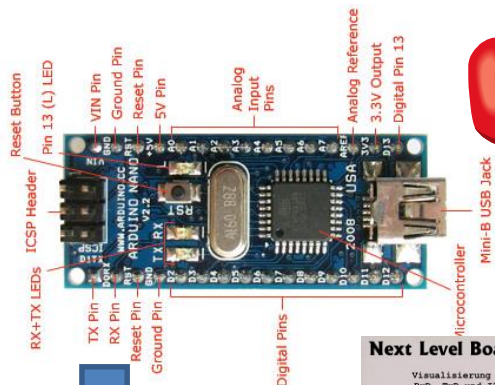
# Rückblick: FTKL- Tagung 2010 – Zukunft?



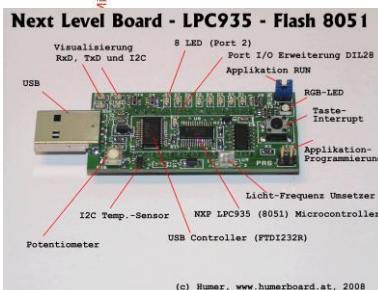
Arduino / AVR o. PIC

Ev. 8051-Flash

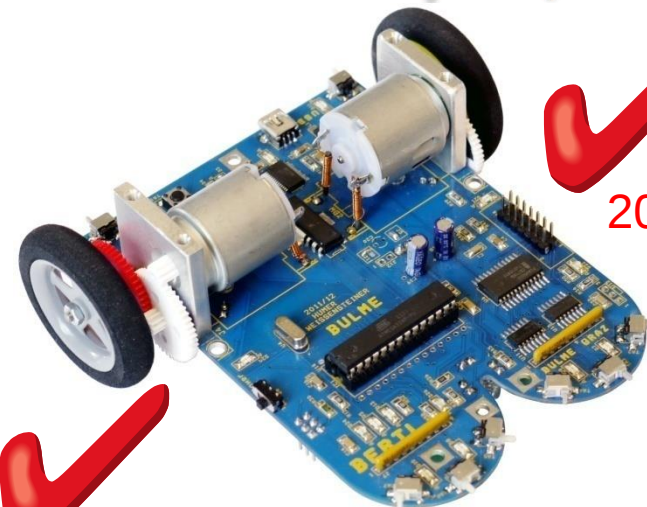
Cortex – M0 o. M3  
mbed



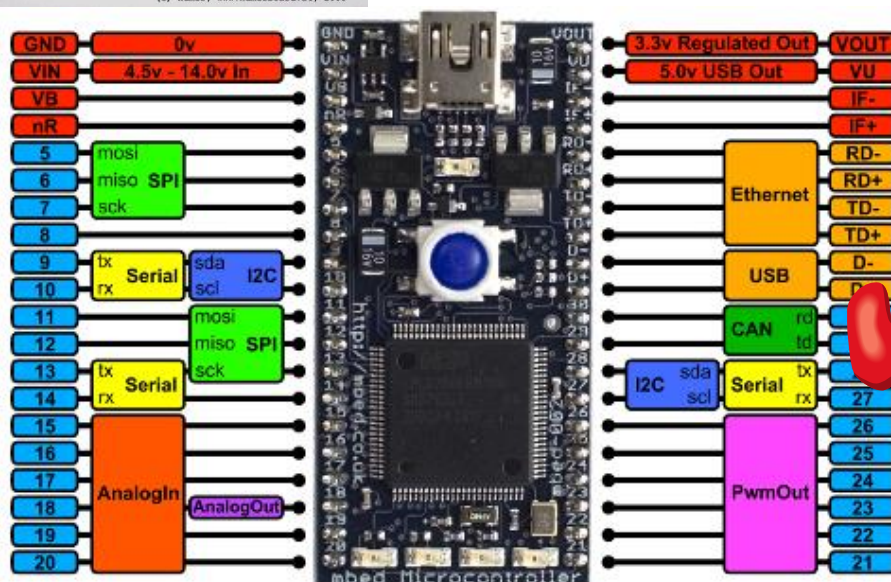
AVR  
2011



8051  
2010

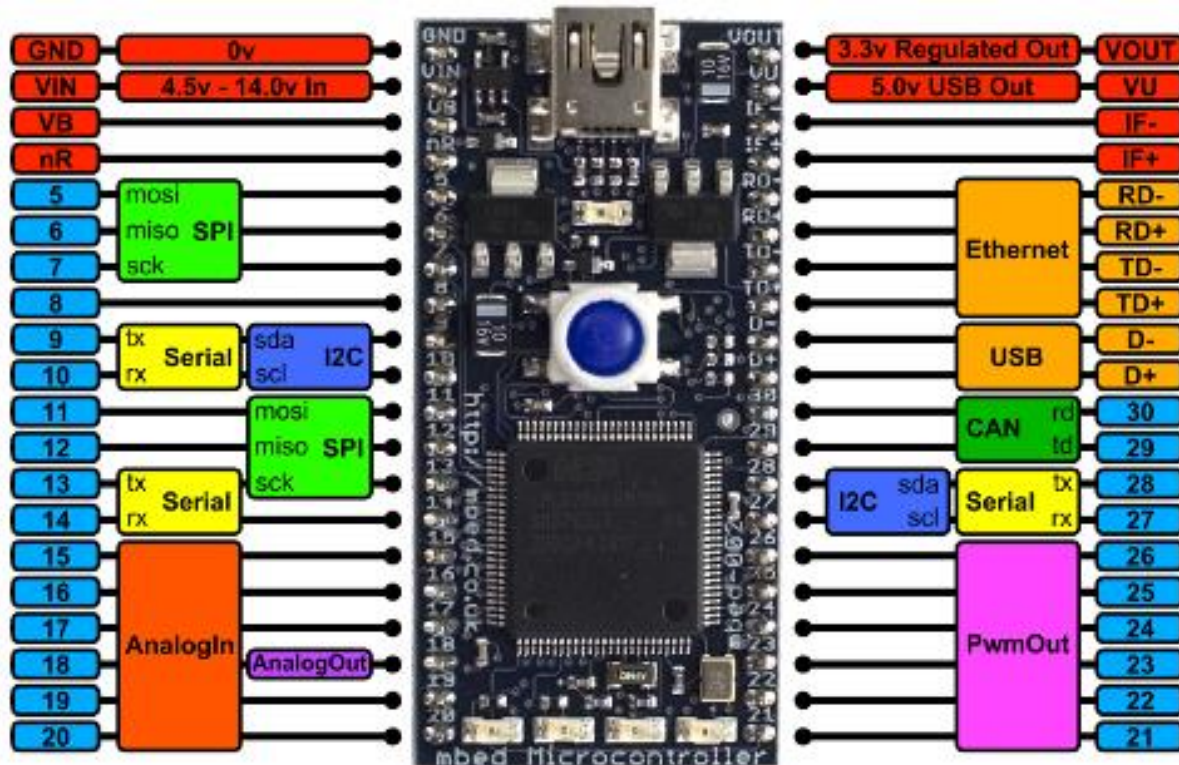


2011



ARM  
2012

## Rückblick: FTKL- Tagung 2012 – Cortex M3 - mbed



[www.mbed.org](http://www.mbed.org)

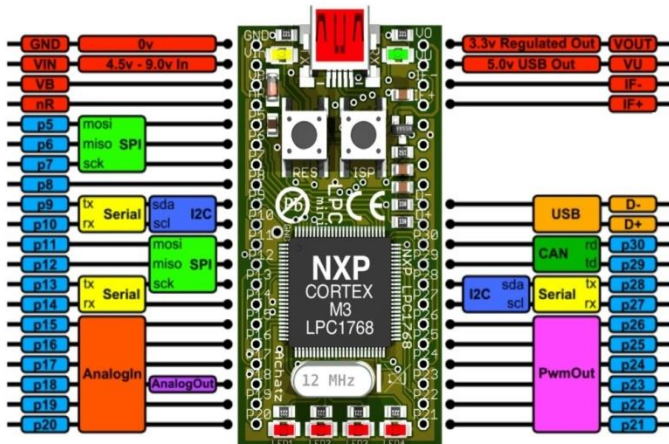
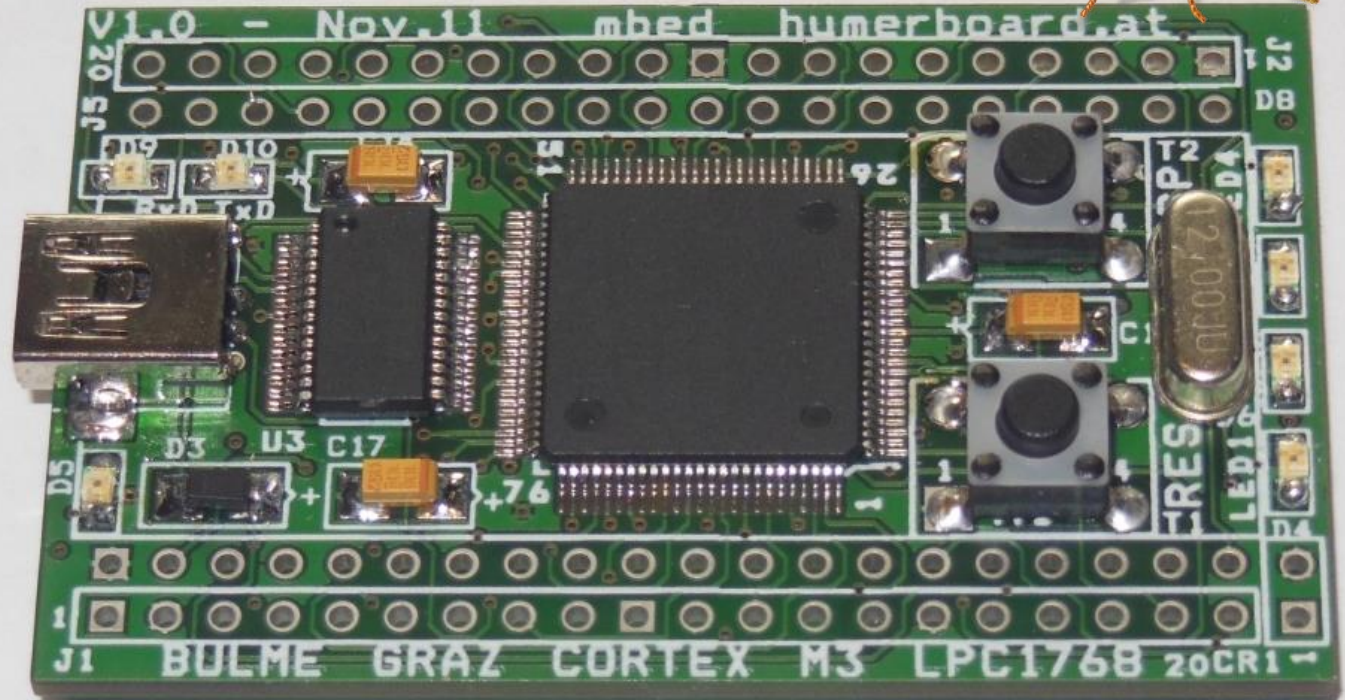
**mbed**  
Online Compiler



ARM-Cortex-M3  
96MHz, 32KB RAM, 512KB FLASH

Ethernet, USB Host/Device, 2xSPI, 2xI2C, 3xUART,  
CAN, 6xPWM, 6xADC, GPIO

## Rückblick: FTKL- Tagung 2012 – Cortex M3 - mbed



Werkstättenprojekt, BULME GRAZ,  
Bauteilkosten ca. €15,--  
**ARM-Cortex-M3, LPC1768**  
**96MHz, 32KB RAM, 512KB FLASH**

## Rückblick: FTKL- Tagung 2012 – Cortex M3 - mbed



mbed-Beispiel: Diplomarbeit „Trap Training System“

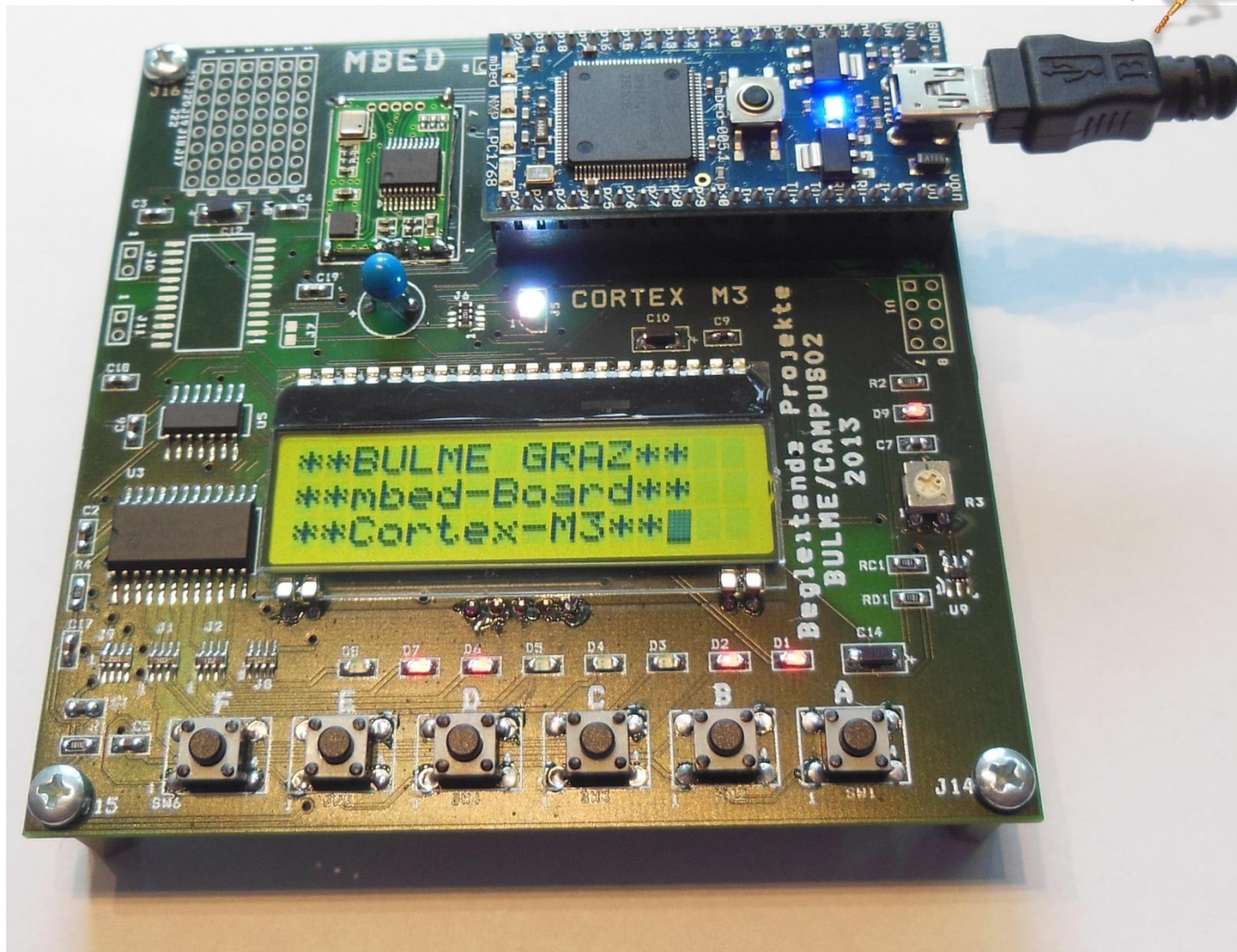


Staatsmeister/Österreichischer Meister 2010+2012+2013

Beschleunigung  
und  
Gyrator 3 Achsen  
Kompass  
Luftdruck  
Puls



## Rückblick - Tagung 2012 – Cortex M3 - mbed



Prototyp, BULME GRAZ, Humer



Break-Out Boards: Beispiel ebay, China, ohne Versandkosten



ca. 18€

## 9-Axis Module

10DOF 9-axis Indicator  
Module L3G4200D ADXL345  
HMC5883L BMP085  
Acceleration Gyro



€13,--

**! BMP085 Air-pressure model altitude weather/  
temperature digital sensor module**



**Calibrated digital sensor**

- ☐ I2C data interface
- ☐ Pressure resolution: 0.01hpa
- ☐ Pressure accuracy:  $\pm 2$ hpa
- ☐ Pressure range: 300~1100hpa
- ☐ Altitude resolution: 1m
- ☐ Altitude range: -689~8948m
- ☐ Compass resolution:  $1^\circ$
- ☐ Compass accuracy:  $\pm 3^\circ$
- ☐ Compass range:  $0^\circ \sim 359^\circ$
- ☐ Temperature resolution:  $0.1^\circ\text{C}$
- ☐ Temperature accuracy:  $\pm 1^\circ\text{C}$
- ☐ Temperature range:  $-40^\circ\text{C} \sim +85^\circ\text{C}$
- ☐ Standby current  $\leq 2\mu\text{A}$
- ☐ Supply voltage: 2.8~3.3V

<http://www.neuhold-elektronik.at/>



## LIPO-Akkus, 3.7V geschützt und ungeschützt



**Bauform 18650/680**  
LIPO 3,7V/4Ah ca. 4€



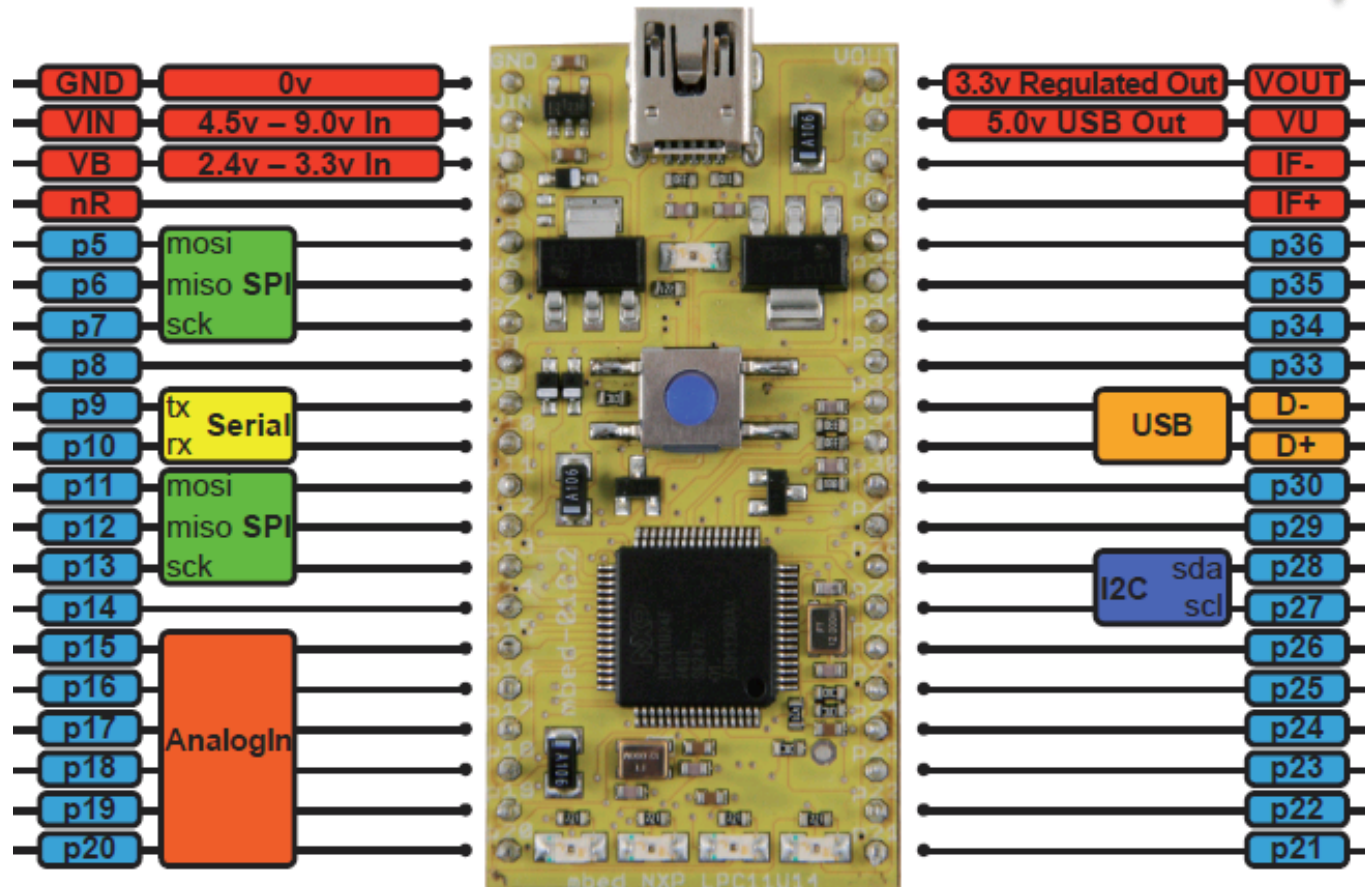
**Bauform 14500 (AA)**  
LIPO 3,7V/1Ah ca. 3€

### Weitere Bauformen:

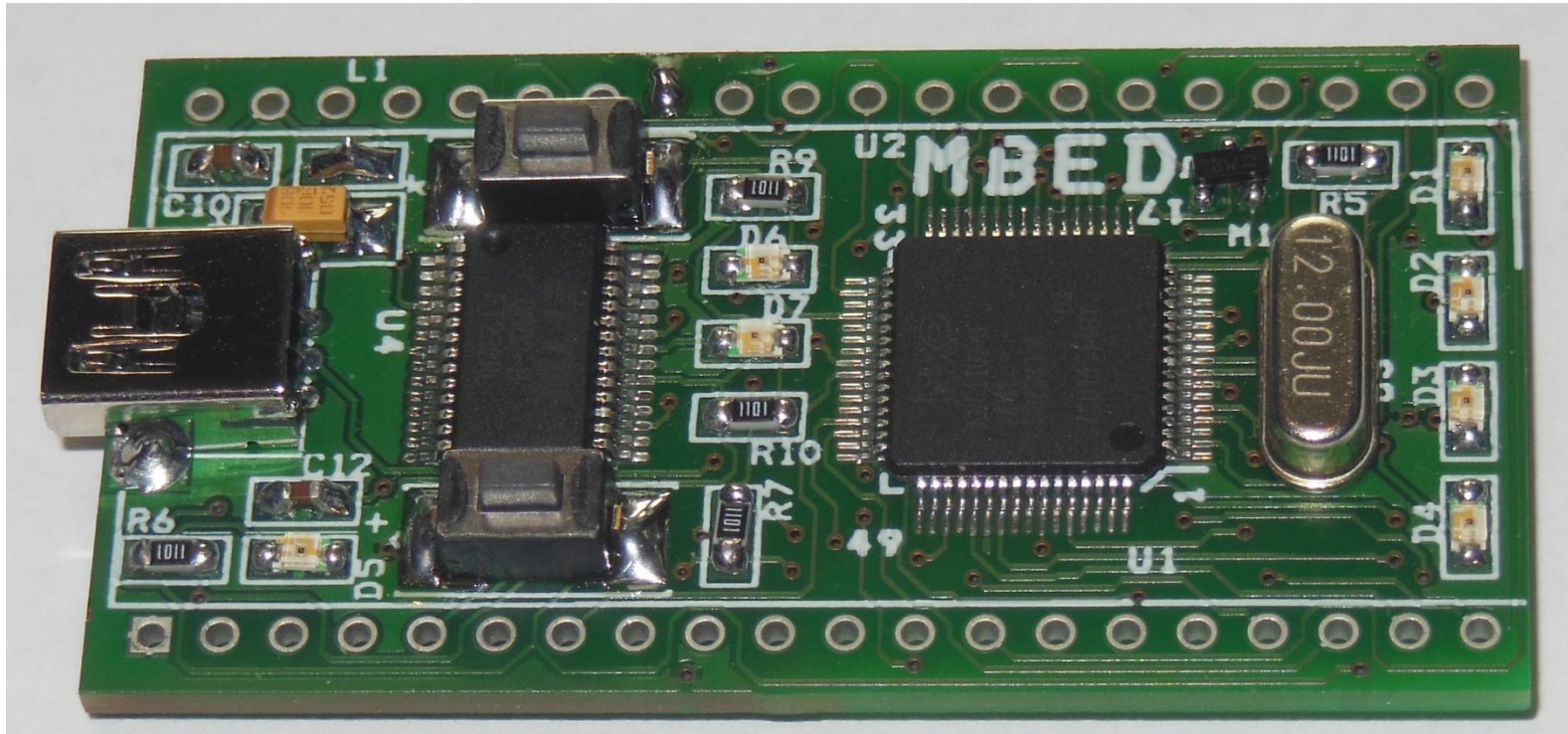
26650 .... bis 6 Ah  
18350  
18500  
18700  
16340 ... CR123A  
10440 ... (AAA), ... 600 mAh  
..... weitere folgen

## FTKL- Tagung 2013 – wos is los?

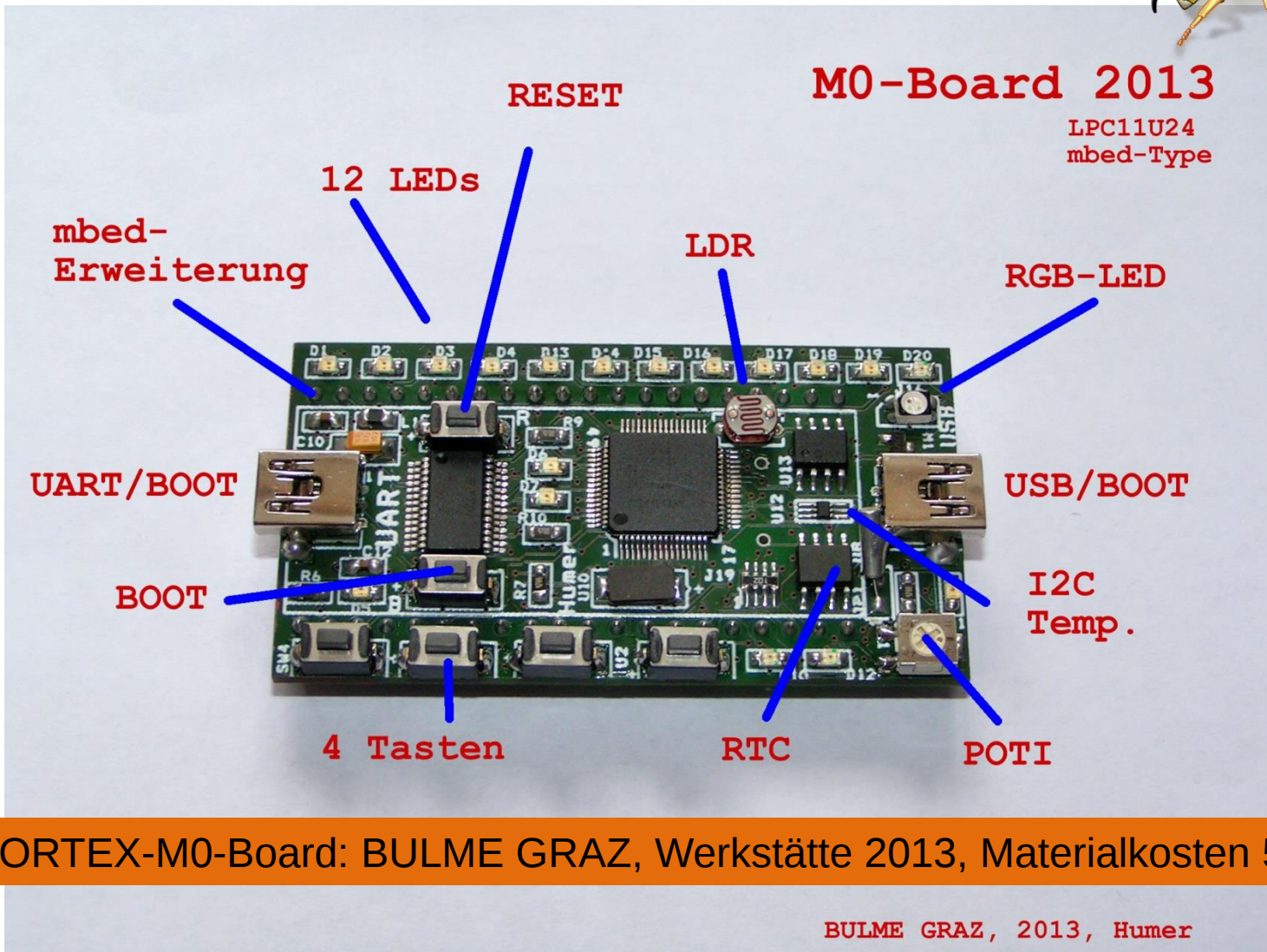




Low power ARM® Cortex™-M0 Core  
48MHz, 8KB RAM, 32KB FLASH  
USB Device, 2xSPI, I2C , UART, 6xADC, GPIO

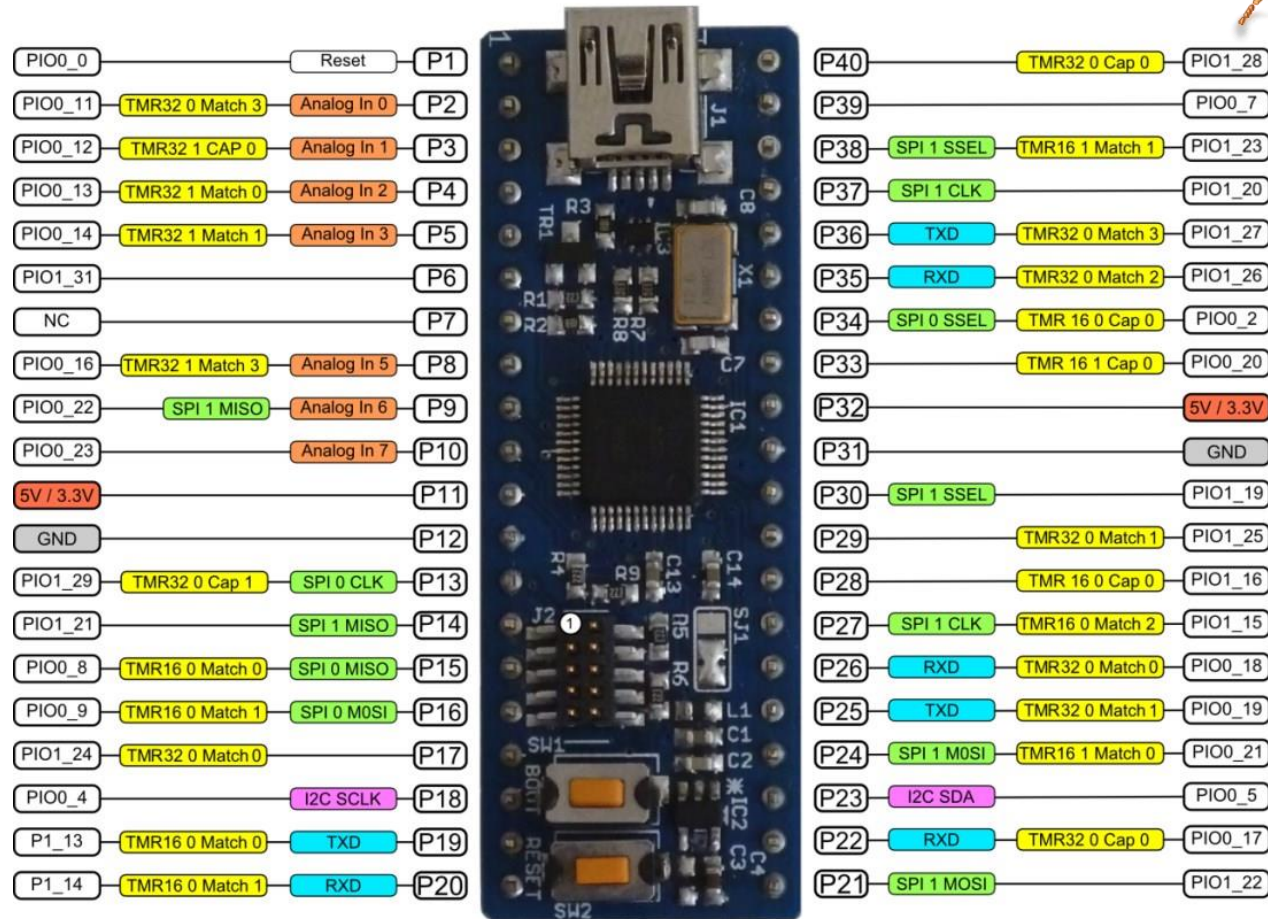


CORTEX-M0-Board: BULME GRAZ, Werkstätte 2012, Materialkosten 9€



CORTEX-M0-Board: BULME GRAZ, Werkstätte 2013, Materialkosten 5..20€

# Zukunft (?) FTKL- Tagung 2014 – Cortex M0 - mbed



Boot button : PIO0\_1  
Reset button : PIO0\_0

CORTEX-M0-Board: BULME GRAZ, Werkstätte 2014, Materialkosten ca.5€



*Etang Electronics*

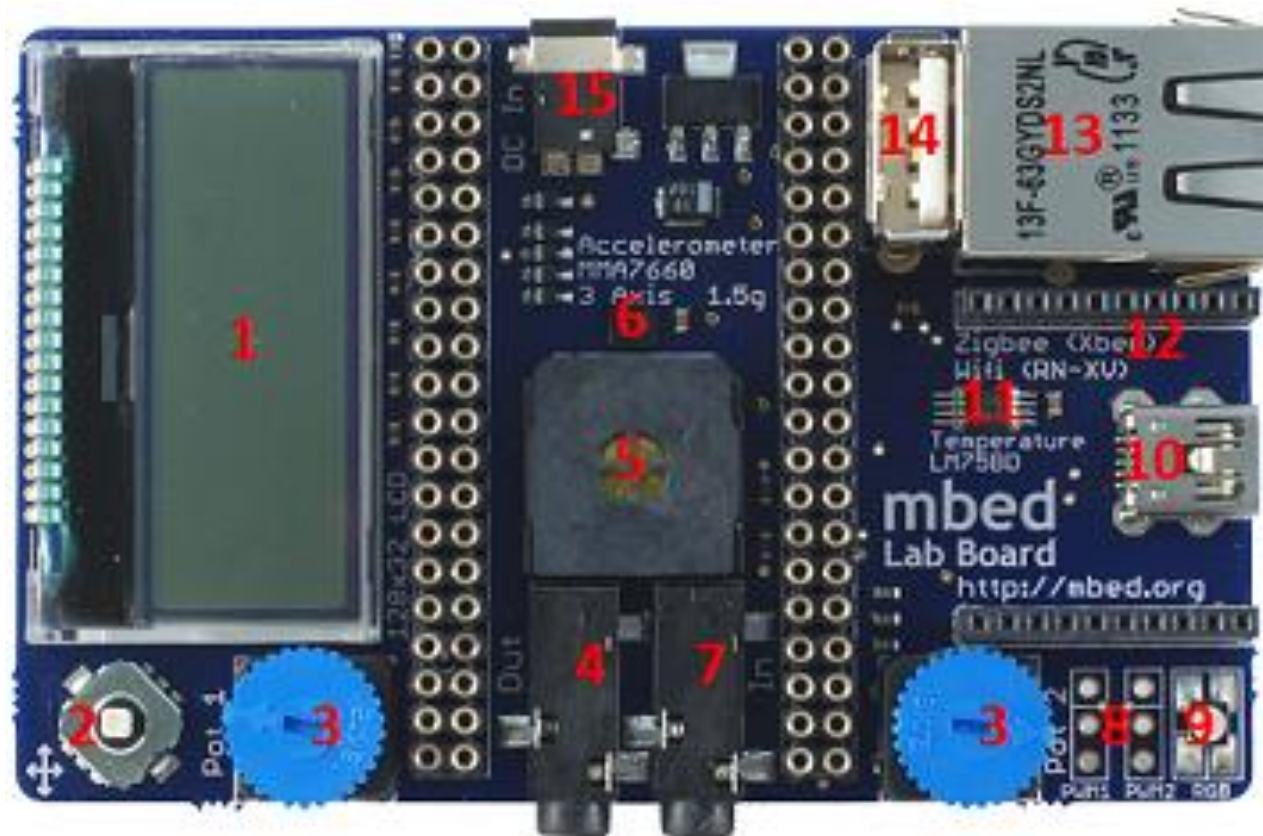


**Dispatch within 24 hours**

CORTEX-M0-Board – DEBUG/KEIL BULME GRAZ, ebay ca.15..30€



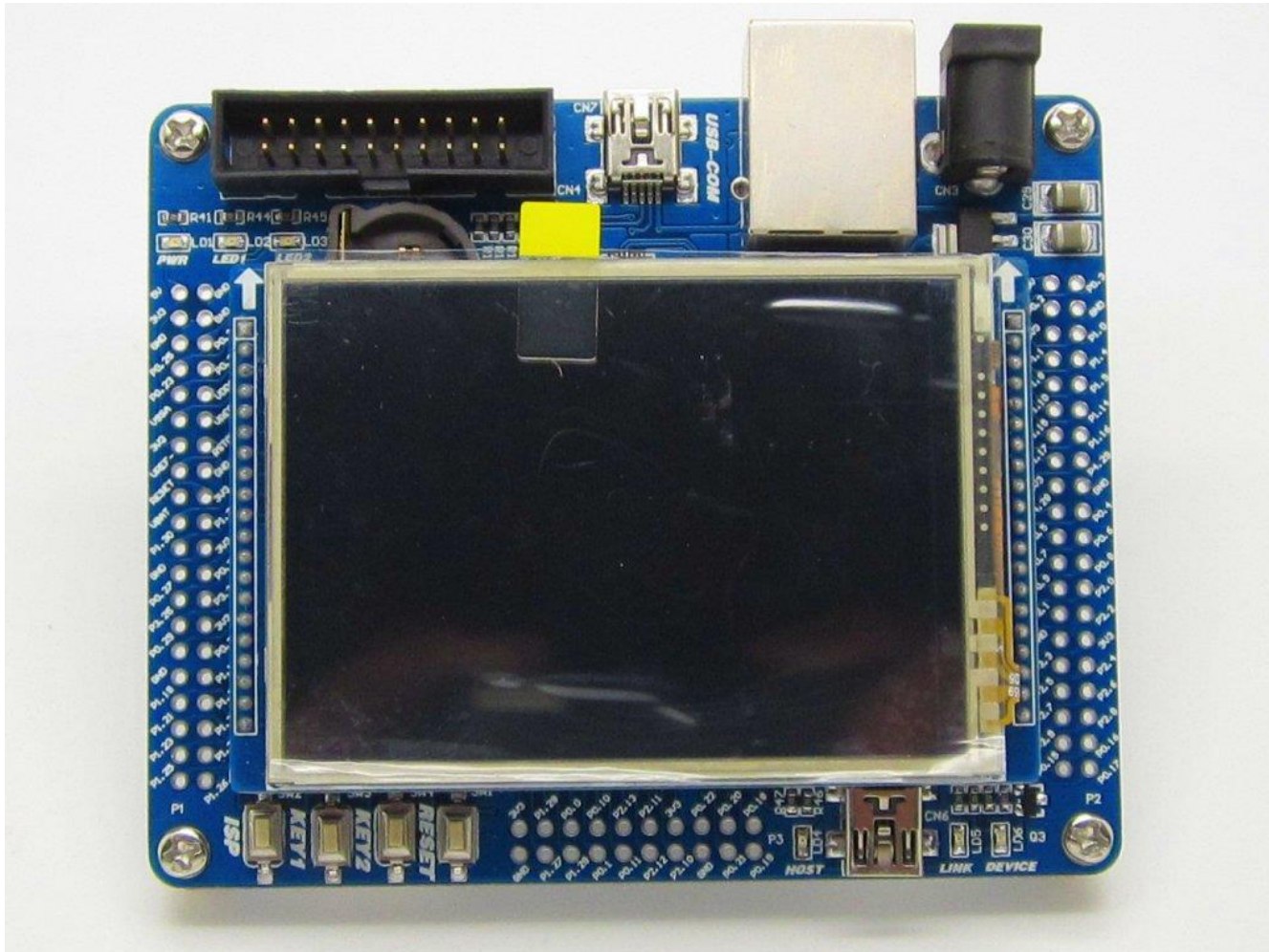
## Erweiterungsboard – mbed – rs-components (40€)



## Bericht: FTKL- Tagung 2012 – Cortex M3 - mbed

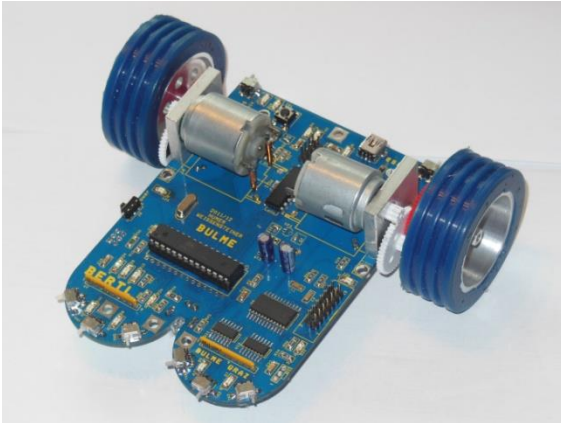


**Ebay-Beispiel: LPC1768+GLCD(SPI) 320x240 Farbe (30€)**

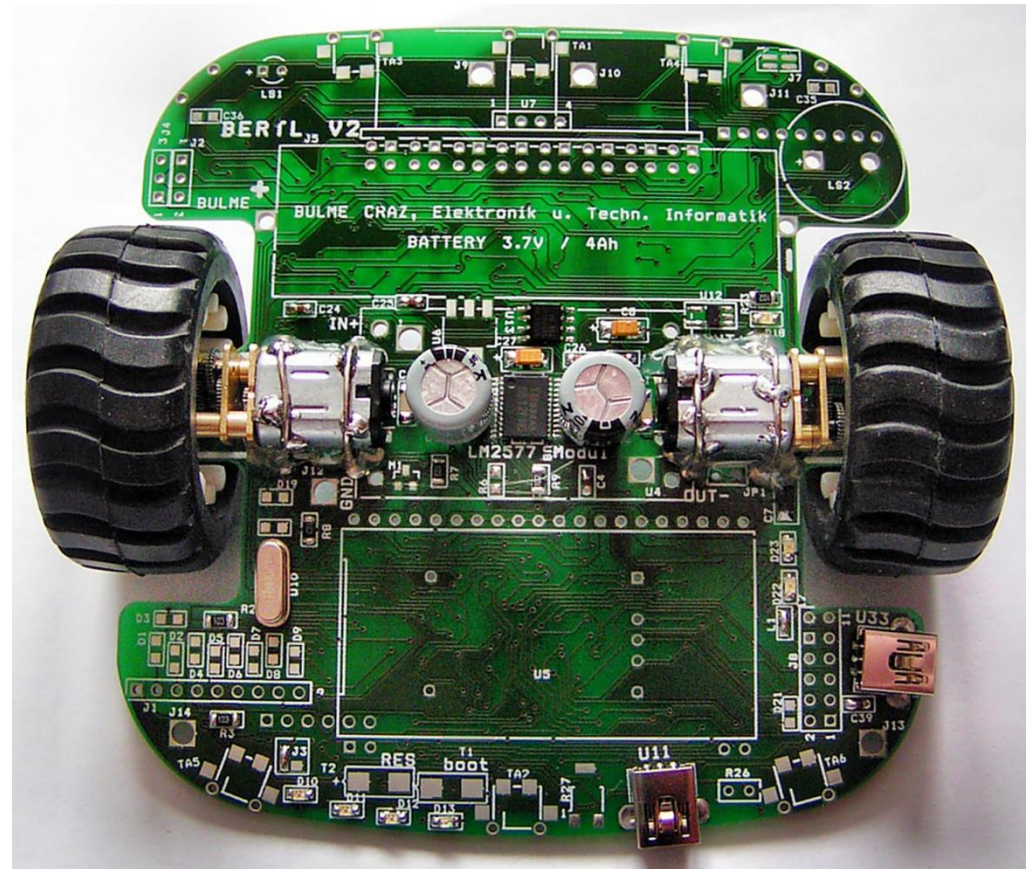




BERTL 2012/2013



BERTL 2014



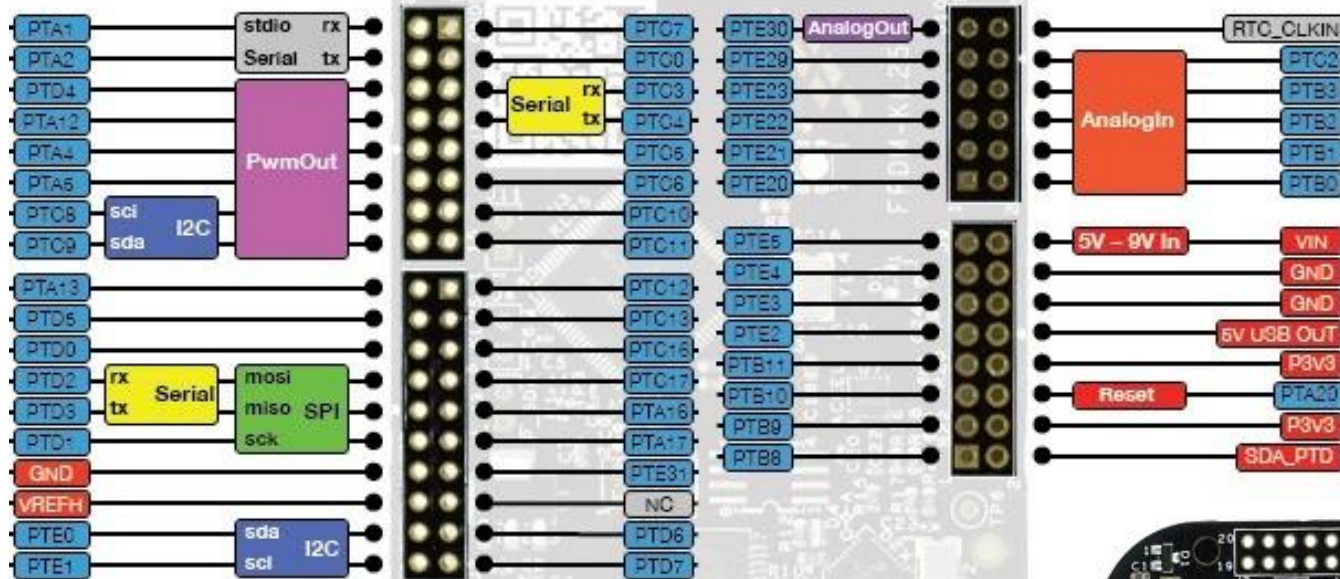


## FTKL- Tagung 2013 – Cortex M0+ - mbed



High performance ARM® Cortex™-M0+ Core  
48MHz, 16KB RAM, 128KB FLASH

2xSPI, 2xI2C, 3xUART, 6xPWM, 6xADC(16bit), Touch Sensor, GPIO



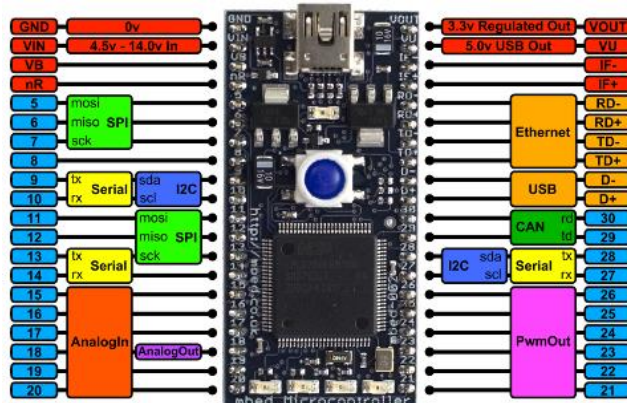
# ARDUINO und MBED



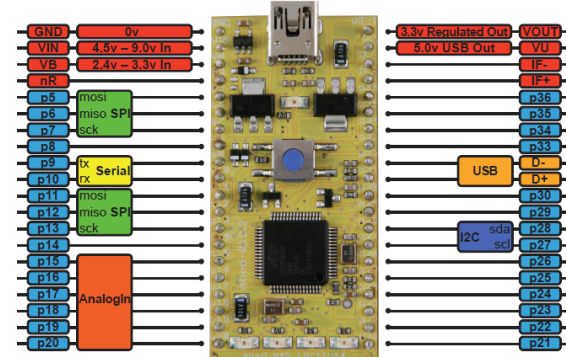
# FTKL- Tagung 2013 – Cortex M0 - mbed



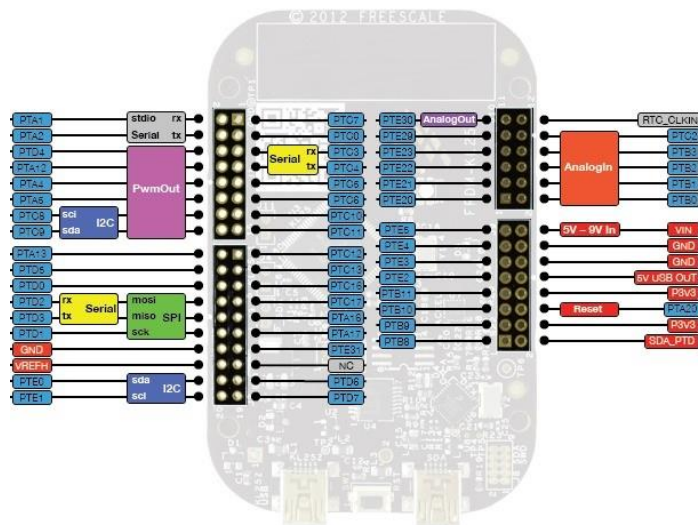
Mbed – Cortex M3/LPC1768 (50€)



Mbed – Cortex M0/LPC11U24 (35€)



Arduino/Mbed – Cortex M0+ (13€)



# FTKL- Tagung 2013 – Zukunft?

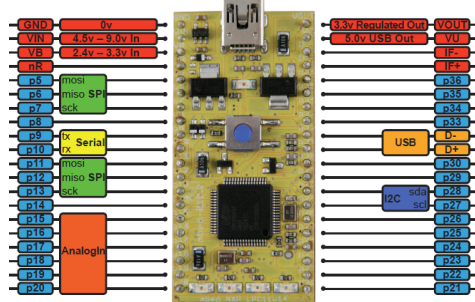


II .. V Jahrgang

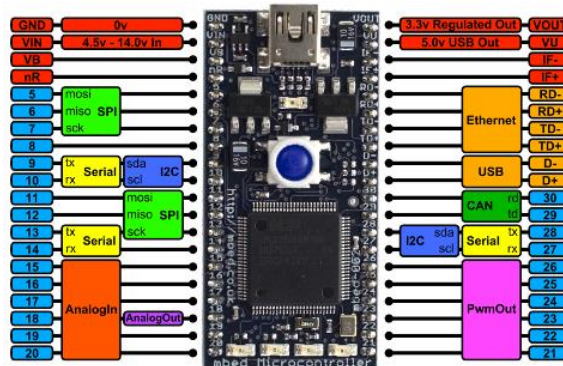
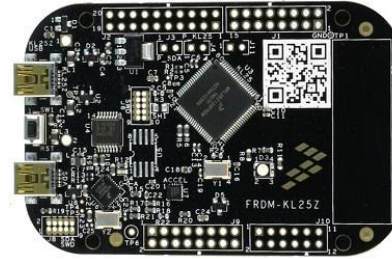
ARM: Cortex-M0/M0+

ARM: Cortex-M3

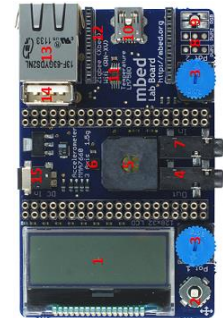
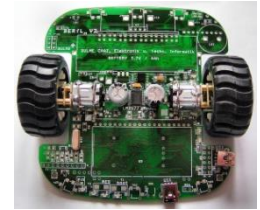
Raspberry + mbed



2014



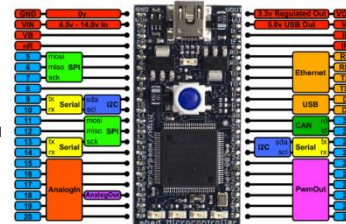
2013



Projekte..



2015







**Vielen Dank!**