Infineon Boards and Shields for Makers

Dr. Johannes Breitschopf,
Distribution Marketing Manager, Europe
Agenda

1. What is Arduino and XMC2Go?
2. Why are Makers important for Infineon & Distributors?
3. Infineon Shields for Arduino
4. XMC 2GO, Sensors 2GO, H-Bridge 2GO
5. Activities and Summary
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What is Arduino?

Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. It's intended for artists, designers, hobbyists and anyone interested in creating interactive objects or environments.

http://arduino.cc/
Who is using Arduino?

› Community: 270,000 Members *
› Forum: 360,919 Members *

* 2017
Most important Arduino Microcontroller Boards

**The Arduino**

is a microcontroller board based on the ATmega328.

**Due**

is a microcontroller board based on the Atmel SAM3X8E ARM Cortex-M3 CPU.

**XMC-1100 Boot Kit** with XMC1100 as the first Arduino compatible microcontroller platform from Infineon.
Infineon XMC1100 Boot Kit

- XMC1100 Boot Kit, fully featured Arduino compatible Evaluation Kit from Infineon based on an XMC1100 Microcontroller.

- The Boot Kit is equipped with an **XMC1100 32-bit Microcontroller in TSSOP-38 at 32 MHz with 64 kB Flash, 16 kB RAM** and the full peripheral set of the XMC1100 series:
  - XMC1100 (**ARM® Cortex™-M0 based**) Microcontroller, TSSOP38
  - Headers compatible with Arduino shield
  - Detachable **SEGGER J-Link debugger** and UART virtual COM port, with micro USB connector
  - Power supply concept compatible with Arduino Uno
  - One LED as required from Arduino board specification and six additional LEDs

**Order Nr.:** KITXMC11BOOT001TOBO1, ISAR

Software Generation Platform: [DAVE™ Download](#)

DAVE™ Application List: [Available DAVE™ APPs](#)

Online Discussion Forums: [DAVE™ Forum & XMC Forum](#)

Implementation of the XMC Boards into the Arduino IDE: [XMC™ software for Arduino IDE](#)
XMC1100 Boot Kit
Block diagram

- Micro USB
- +5V
- Voltage Regulator
- +3.3V
- XMC4200 Debug IC
- COM LED
- Debug LED
- SWD
- SPD
- UART

- Pin Header IOL
  1x10, 0.1"

- Pin Header IOH
  1x8, 0.1"

- EVR
- U0C1
- CCU4
- Debug U0C0
- BSL
- XMC1100 TSSOP38
- ADC
- Pin Header POWER
  1x8, 0.1"

- Pin Header AD
  1x6, 0.1"

XMC1100 for ARDUINO™
More Arduino compatible XMC Microcontroller Boards from Infineon

Since 2016 three more XMC Microcontroller Boards are available:

- XMC4300 Relax EtherCat Kit, XMC4300-F100 Microcontroller based on ARM® Cortex®-M4 @ 144MHz, integrated EtherCAT® Slave Controller, 256kB Flash and 128kB RAM

- XMC4700 Relax Lite Kit, XMC4700-F144 Microcontroller based on ARM® Cortex®-M4 @ 144MHz, 2MB Flash and 352kB RAM

- XMC4700 Relax Kit for 5V Shields, XMC4700-F144 Microcontroller based on ARM® Cortex®-M4 @ 144MHz, 2MB Flash and 352kB RAM

- XMC4800 Relax EtherCAT Kit, XMC4800-F144 Microcontroller based on ARM® Cortex®-M4@144MHz, integrated EtherCAT® Slave Controller, 2MB Flash and 352kB RAM

- Hitex ShieldBuddy TC275, TC275 32-bit multicore processor on a board following the Arduino standard Automotive qualified TC275 32-bit multicore processor
What is XMC2GO?

- XMC2GO Kits are the smallest, fully featured Evaluation Kits from Infineon based on a 32-bit XMC1100 Microcontroller.

- The XMC 2Go Kit with XMC1100 is maybe the world’s smallest, fully featured Microcontroller Evaluation Kit showcasing:
  - XMC1100 (ARM® Cortex™-M0 based) at 32 MHz, 64 kB Flash, 16 kB RAM
  - On-board J-Link Lite Debugger (Realized with XMC4200 Microcontroller)
  - Power over USB (Micro USB)
  - ESD and reverse current protection
  - 2 x user LED
  - Pin Header 2x8 Pins suitable for Breadboard

- All other 2GO Kits are based on this XMC2GO Kit and include another IC from Infineon such as an H-Bridge, 3d Sensor and a Current Sensor

Order Nr.: KIT_XMC_2GO_XMC1100_V1, ISAR
Software Generation Platform: DAVE™ Download
DAVE™ Application List: Available DAVE™ APPs
Online Discussion Forums: DAVE™ Forum & XMC Forum
Implementation of the XMC Boards into the Arduino IDE: XMC™ software for Arduino IDE
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Motivation & Goals Arduino / XMC2GO

- Real & affordable P2S solutions for customers and makers
- Create more awareness of Infineon products in the mass market
- Be present in the mass market through existing communities
  - > 470k users will know & will talk about Infineon’s solutions !!!
    - Arduino (~361k users)
    - German Arduino forum (>4k users)
    - IFX Forum (>2k users)
    - Social Media (>100k “friends”)
    - University Program (>300 Institutes with > 3k students)
- Free-up resources within IFX
  - SW, Code Examples, FAQ done by community
  - Get new interesting application ideas from the makers for future product design
- Large number of startups
Motivation & Goals Arduino / XMC2GO

Motivation & Goals Arduino / XMC2GO

Abb. 4: Hauptsitz der Startups nach Bundesländern und Gründerregionen (2016)*

- Hamburg
- Berlin
- Hannover/Oldenburg
- Metropolregion Rhein-Ruhr
- Stuttgart/Karlsruhe
- München

n-Wert: 1.224
Vorjahreswerte in Klammern
Quelle: DSM 2016
Advantages for Makers & Infineon/Distribution

- **Customer Benefits:**
  - Faster field test of components
  - Easier prototyping / development
  - Outsourcing of Software development (e.g. [https://github.com/](https://github.com/))
  - Bug fixing through online community (361k members)
  - Saving money with a standard form factor

- **Infineon/Distribution Benefits:**
  - Makers are future engineers
  - Startups out of the Maker scene can grow to successful companies
  - You can showcase P2S solution in a small form factor
  - You can gain additional awareness in the mass market
  - You can easier change/update existing Demos
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Shields for Arduino from Infineon: Overview

Since 2015 Shields for Arduino from Infineon are available:

- RGB LED Lighting Shield with XMC1202, XMC1202 (ARM® Cortex™-M0 based)
- DC Motor Control Shield with BTN8982TA, 2x half bridge BTN9882TA
- 24V Protected Switch Shield, 2x smart high side switch BTT6030-2EKA and 1x BTT6020-1EKA
- Low Side Switch Shield with BTF3050TE, 3x smart low side switch BTF3050TE
- Protected Switch Shield with BTS50015-1TAD, 1x smart high side switch BTS50015-1TAD
- DC Motor Shield with TLE94112EL, 1x multi half bridge TLE94112EL
RGB LED Lighting Shield

RGB LED lighting shield is designed to be easily configurable and combinable for different LED light engines and lamps, for fast prototyping and in-expensive evaluation of LED lighting applications.

- 3-channel dimmable DC-DC buck LED (input voltage must be higher than the forward voltage of the LED strings)
- **Drives and dims up to 3 LED strings with constant current**
- **High speed flicker-free modulation dimming on each string with Pulse-Density Modulation (PDM)**
- Very high power density due to high switching frequency (Up to 1.5 MHz)
- Configurable current amplitude and current ripple
- I²C interface with configurable 10-bit slave address
- Up to 48V_{DC} input (60V)
- **Up to 700mA output (1A)**
- Isolated DMX512 (optional)

- Shield for Arduino from Infineon, [www.infineon.com/shields-for-arduino](http://www.infineon.com/shields-for-arduino)

- Shield available
  - ISAR
RGB LED Lighting Shield
RGB LED Lighting Shield
Demo: App controlled RGB LED Light

Target Applications:
LED lighting

RGB LED Shield
Bluetooth Shield
Boot Kit
Standard RGB LED Light
DC Motor Control Shield with BTN8982TA

- The Motor Control Shield is equipped with 2x BTN8982TA Half-Bridge (NovalithIC™) for Motor Control for
  - 2 x uni-directional Motor Control (Current limitation level of 55 A min.)
  - Bi-directional Motor Control in an H-Bridge configuration
  - Functional range: 6 V – 40 V; Nominal range: 8 V – 18 V, up to 70 A $I_{\text{nom}}$ Output, $I_{\text{sense}}$
  - **Capable of high frequency PWM, e.g. 30 kHz**
  - Adjustable slew rates for optimized EMI by changing external resistor
  - Driver circuit with logic level inputs
  - **Diagnosis with current sense**
  - Protection e.g. against overtemperature and overcurrent, reverse polarity (Shield)

- Shield for Arduino from Infineon, [www.infineon.com/shields-for-arduino](http://www.infineon.com/shields-for-arduino)

- Shield available
  - ISAR
DC Motor Control Shield with BTN8982T

Application diagram
DC Motor Control Shield with BTN8982TA

- Arduino Connector
- IPD90P03P4L-04 (reverse polarity protection)
- VBAT
- Output device 1
- GND
- Output device 2
- NovalithIC™ BTN8982TA
Motor Control Shield with BTN8982TA Demo: Engine Cooling Fan

Target Applications:
Brushed DC motor control up to 250W (600W) continuous load

- Engine cooling fan
- Motor Control Shield
- Boot Kit
The 24V Protected Switch Shield is equipped with 2x BTT6030-2EKA and 1x BTT6020-1EKA protected high side switch.

- Drives resistive, capacitive and inductive loads with PWM or in DC (e.g., truck bulbs, car bulbs, valves, motors, relays, capacitors, LEDs)
- **Functional range:** 5 V – 48 V; **Nominal range:** 8 V – 36 V
- Nominal Current up to 5 A per channel restricted due to the limited power dissipation of the PCB (BTT6020-1EKA nominal Current: 7 A, (Rdson 20/30 mΩ))
- **Diagnosis of the load / current feedback**
- **Protection (OV, OT, OC, auto-restart) of load and driver circuit, reverse polarity (Shield)**

- Shield for Arduino from Infineon, [www.infineon.com/shields-for-arduino](http://www.infineon.com/shields-for-arduino)

- Shield available
  - ISAR
24V Protected Switch Shield with BTT6030-2EKA and BTT6020-1EKA  Block diagram of the 24V Shield
24V Protected Switch Shield with BTT6030-2EKA and BTT6020-1EKA
24V Protected Switch Shield Demo: Hydraulic Valves and Motor

Target Applications:
Drive resistive, capacitive and inductive loads with PWM or DC. E.g. truck bulbs, valves, motors, relays, capacitors ...
The Low-Side Switch Shield from Infineon consists out of three BTF3050TE protected low side switch

- Drives resistive, capacitive and inductive loads with PWM or in DC (e.g. truck bulbs, car bulbs, valves, motors, relays, capacitors, LEDs)
- Nominal battery voltage: 8 to 18, extended battery voltage: 3 to 28V
- Nominal load current: 3 A Protection of load and driver circuit (Rdson 50 mΩ)
- Capable of PWM up to 14 kHz (at 10% duty cycle)
- Protection of load (OV, OT, OC, auto-restart) and driver circuit

Shield for Arduino from Infineon, www.infineon.com/shields-for-arduino

Shield available
- ISAR
Low Side Switch Shield with BTF3050TE
Application circuit for BTF3050TE

*Consider design recommendations for parasitic C_{SRP,GND}
Low Side Switch Shield with BTF3050TE
Low Side Switch Shield with BTF3050TE Demo: Hydraulic Valves and Motor (as before)

Target Applications:
Drive resistive, capacitive and inductive loads with PWM or DC Bulbs, valves, motors, relays, solenoids, flaps and safety locks heating elements, such as PTC auxiliary heater or lambda sensors

Valves
Low Side Switch Shield
Boot Kit
Water pump
The protected switch shield contains one Power Profet BTS50015-TAD protected high side switch

- Suitable for resistive, inductive and capacitive loads
- Output voltage range nom. $V_{Bat} = 8V \ldots 18V$, ext. $5.3V \ldots 28V$
- Nominal current up to 33 A ($R_{dson} 1.5 \, m\Omega$)
- Power supply should be protected
- Protection of load (OV, OT, OC, auto-restart) and driver circuit, reverse polarity (device)

Shield for Arduino from Infineon, [www.infineon.com/shields-for-arduino](http://www.infineon.com/shields-for-arduino)

Shield available:
- ISAR
Protected Switch Shield with BTS50015-1TAD
Application circuit for BTS50015-1TAD

ext. components acc. to either (A) or (B) required, not both
Protected Switch Shield with BTS50015-1TAD

- BTS50015-1TAD
- TLC274CD operational amplifier
- TLS805B1SJ voltage regulator
Target Applications:
Relay and fuse replacement in power distribution and junction boxes, resistive, inductive and capacitive loads such as heating resistors, filter capacitors, motor, valves and pumps, high current applications such as ECU power feeds, auxiliary power outlets, PTC heaters and rear window heaters, systems with high switching cycles and high energy requirements such as “start-stop” and electric brake vacuum pumps, general purpose for power distribution and heating applications such as HVAC blower, glow plug control unit and trailer node.
DC Motor Shield with TLE94112EL

- 1x TLE94112EL twelve-fold monolithic half-bridge
  - Especially for automotive motion control applications such as Heating, Ventilation and Air Conditioning (HVAC) flap DC motor control.
  - Output voltage range $V_{\text{Bat}} = 5.5V \ldots 20V$
  - Current range $\geq 12 \times 0.9A$ or battery
  - **SPI Interface** for control and diagnosis
  - **Protection** of load (SC UV, OV, OT, OL, auto-restart) and driver circuit, reverse polarity (Shield)

- Shield for Arduino from Infineon, [www.infineon.com/shields-for-arduino](http://www.infineon.com/shields-for-arduino)

- Shield available:
  - ISAR
DC Motor Shield with TLE94112EL
Application diagram motor control with TLE94112EL
DC Motor Shield with TLE94112EL

- **TLE94112EL**
- 100 nF/50V VDD
- 100 nF/50V VS1
- 100 nF/50V VS2
- GND
- OUT2
- OUT1
- OUT5
- OUT6
- OUT4
- OUT3
- GND
- VBAT
- Active reverse battery protection With IPD50P04P4L-11
- Transient Voltage Suppressor
- 47 μF /50V Capacitor
DC Motor Shield with TLE94112EL Demo: HVAC Flaps

Target Applications:
Multi-motor applications, e.g. DC motors and voltage controlled bipolar stepper motors, toys, HVAC systems, any other inductive, capacitive and resistive loads, e.g. monostable relays, bistable relays and LED

6x HVAC flaps turning
DC Motor Shield
Arduino Uno
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Since 2016 more XMC2GO Microcontroller Boards are available:

- **XMC2GO**, XMC1100 (ARM® Cortex™-M0 based)

- **Current Sensor 2GO**, XMC2GO + TLI4970-D050T4 high-precision magnetic current sensor

- **3D Magnetic Sensor 2GO**, XMC2GO + TLV493D-A1B6 3D magnetic sensor

- **H-Bridge 2GO**, XMC2GO + IFX9201SG smart H-Bridge for loads up to 6A and 36V
What is XMC2GO?

- XMC2GO Kits are the smallest, fully featured Evaluation Kits from Infineon based on a 32-bit XMC1000 Microcontroller.

- The XMC 2Go Kit with XMC1100 is maybe the world’s smallest, fully featured Microcontroller Evaluation Kit showcasing:
  - XMC1100 (ARM® Cortex™-M0 based) at 32 MHz, 64 kB Flash, 16 kB RAM
  - On-board J-Link Lite Debugger (Realized with XMC4200 Microcontroller)
  - Power over USB (Micro USB)
  - ESD and reverse current protection
  - 2 x user LED
  - Pin Header 2x8 Pins suitable for Breadboard.

- All other 2GO Kits are based on this XMC2GO Kit and include another IC from Infineon such as an H-Bridge, 3d Sensor and a Current Sensor

Order Nr.: KIT_XMC_2GO_XMC1100_V1, ISAR
Software Generation Platform: DAVE™ Download
DAVE™ Application List: Available DAVE™ APPs
Online Discussion Forums: DAVE™ Forum & XMC Forum
Implementation of the XMC Boards into the Arduino IDE: XMC™ software for Arduino IDE
The Current Sensor 2GO Kit is a budget-priced evaluation board equipped with a current sensor:

- XMC1100 (ARM® Cortex™-M0 based)
- On-board J-Link Lite Debugger (Realized with XMC4200 Microcontroller)
- Power over USB (Micro USB)
- ESD and reverse current protection
- 2 x user LED
- Pin Header 2x8 Pins suitable for Breadboard.

TLI4970-D050T4 (current sensor with digital interface):
- **AC & DC measurement range up to ±50 A**
- Highly accurate over temperature range and lifetime
- **max. 1.0 % (0 h), 1.6 % (over lifetime) of indicated value**
- Low offset error (max. 25 mA at room temperature)
- High magnetic stray field suppression
- Fast over current detection with configurable threshold
- **Galvanic isolation up to 2.5 kV max. rated isolation voltage (according to UL 1577)**
- 16 bit digital SPI output (13 bit current value)
- Small 7 mm x 7 mm SMD package

Kit available:
- ISAR
Current Sensor TLI4970-D050T4
Block diagram
Current Sensor 2GO

TLI4970-D050T4

IP+

OCD, CS, SCLK, DOUT, VDD, GND

IP-

XMC2GO
Current Sensor 2GO, Demo: Current Sense

Target Applications:
Photovoltaic and general purpose inverters, power supplies (SMPS), battery charger, lighting applications, electrical drives
3D Magnetic Sensor 2GO

- The 3D Magnetic Sensor 2GO is a budget-priced evaluation board equipped with a magnetic sensor for three dimensional measurement
  - XMC1100 (ARM® Cortex™-M0 based)
  - On-board J-Link Lite Debugger (Realized with XMC4200 Microcontroller)
  - Power over USB (Micro USB)
  - ESD and reverse current protection
  - 2x user LED
  - Pin Header 2x8 Pins suitable for Breadboard.

- TLV493D-A1B6 (three dimensional magnetic sensor)
  - Power down/low power mode with 7nA/µ10A power consumption
  - I2C interface up to 1 MBit/sec
  - 12 bit data resolution for each measurement direction
  - Bx, By and Bz linear field measurement up to +/−130mT
  - Excellent matching of X/Y measurement for accurate angle sensing
  - Supply voltage range = 2.8V...3.5V, Temperature range Tj = -40°C...125°C
  - Small, industrial 6 pin TSOP package
  - Triggering by external µC possible
  - Interrupt signal available to wake up a microcontroller
  - Temperature measurement

- Kit available:
  - ISAR
3D Magnetic Sensor
Application diagram

R_{1/2} = 1.2 \, k\Omega
C_1 = 100 \, nF
R = 100 \, \Omega
C = 200 \, pF
3D Magnetic Sensor 2GO
Demo: Joystick

Target Applications:
Joystick e.g. finger, thumb and gaming paddles, E-meters
e.g. anti-tampering, control elements e.g. white goods,
multifunction knob
H-Bridge Kit 2GO

- The H-Bridge Kit 2GO is a ready to use evaluation kit. It is fully populated with all electronic components equipped with the H-Bridge IFX9201SG
  - XMC1100 (ARM® Cortex™-M0 based)
  - On-board J-Link Lite Debugger (Realized with XMC4200 Microcontroller)
  - Power over USB (Micro USB)
  - ESD and reverse current protection
  - 2 x user LED
  - Pin Header 2x8 Pins suitable for Breadboard.

IFX9201SG (general purpose 6A H-bridge)
- RDSon (typ.) < 100mΩ per switch
- **Operation Voltage 4.5V to 36 V**
- Logic inputs: 3.3-V and 5-V TTL/ 5-V CMOS compatible
- Low standby current
- **Short circuit and over-temperature protection**
- VS under-voltage protection
- Open load detection in ON and OFF state
- **Detailed SPI diagnosis or simple error flag**

Kit available:
- ISAR
H-Bridge Kit 2GO

Block diagram
DC Motor Shield with TLE94112EL
H-Bridge Kit 2GO Demo: Marble Run

Target Applications:
DC motor control for industrial applications, home and building automation, power tools, battery management, industrial robotic applications, electric toys applications

Magnetic Sensors
Motor
H-Bridge Kit 2GO
Success Story

- Second best launch/road test at Farnell ever
- Forum activities started, even without promotion of the Shields
- Surprising press response, various articles

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Arduino Status
what happened since

- Award in February 2015 – Product of the Month
  - By “elektronik industrie” for our RGB LED Lighting & DC Motor Control shields

- Landing page [www.infineon.com/shields-for-arduino](http://www.infineon.com/shields-for-arduino)

- Economic Viability @ company “Embest”
  - Shields, Compliance, Prototyping & Production set-up (e.g. HITFET = ~ 11, BTN9882, BTT6030, …)
  - Road test with the DC Motor Control Shield and the RGB LED Shield (2015), DC Motor Shield (2017)

- Internal & External promotion
  - AE´s, FAE´s & PM´s from ATV, PMM & CCS plus University network

- More additional shields completed
  - PROFET+ 24V with 2 x BTT6030 / 1x BTT6020 / HITFET+ with 3 x BTF3050TE …..
Arduino Status
what happened since

- Participate Arduino Day and more in 2016
  - 24 hours-long event organized by community in 262 locations worldwide
  - Make Munich, January 2016
  - TECHFEST, UnternehmerTUM, Garching, Workshop: „Electronics made easy” with tools from Infineon. September 2016

- **Makers Corner at Electronica 2016**
  - Presenting all available Kit2GO and Shields for Arduino including Demonstrators

- **Makers Corner at Embedded World 2017**
  - Presenting all available Kit2Go and Shields for Arduino including Demonstrators
  - Setup of an IFX webpage with all tools for makers, Arduino, XMC, Kits2Go:
    - [www.infineon.com/makers](http://www.infineon.com/makers)

- **Implementation of XMC Boards into the Arduino IDE**
  - Coding in Arduino IDE, select XMC Boards in the IDE and flash the software
  - [https://github.com/Infineon/XMC-for-Arduino](https://github.com/Infineon/XMC-for-Arduino)
Integration of Infineon's XMC Microcontrollers into the Arduino IDE

Visit: https://github.com/Infineon/XMC-for-Arduino
Arduino Outlook

- Industry partner @ UnternehmerTUM, Garching, digital hub “Mobility”, tools (Shields, 2Go kit...) in the electronic pool for Start Ups, MakerSpace
- Techfest 2017 @ UnternehmerTUM, sponsor, active participation
- Participate Make Munich in 2017
- More Shields to come!!!!
Summary

- Arduino is the standard form factor for makers
- Makers have a big potential for your and our customer
- Infineon offers a solid and growing collection of maker tools
- Self running business with low support requirements

- Weblinks:
  - Free Software Generation Platform: [DAVE™ Download](#)
  - DAVE™ Application List: [Available DAVE™ APPs](#)
  - Online Discussion Forums: [DAVE™ Forum & XMC Forum](#)
  - Implementation of the XMC Boards into the Arduino IDE: [XMC™ software for Arduino IDE](#)
  - Makers Landing page: [www.infineon.com/makers](#)
Part of your life. Part of tomorrow.