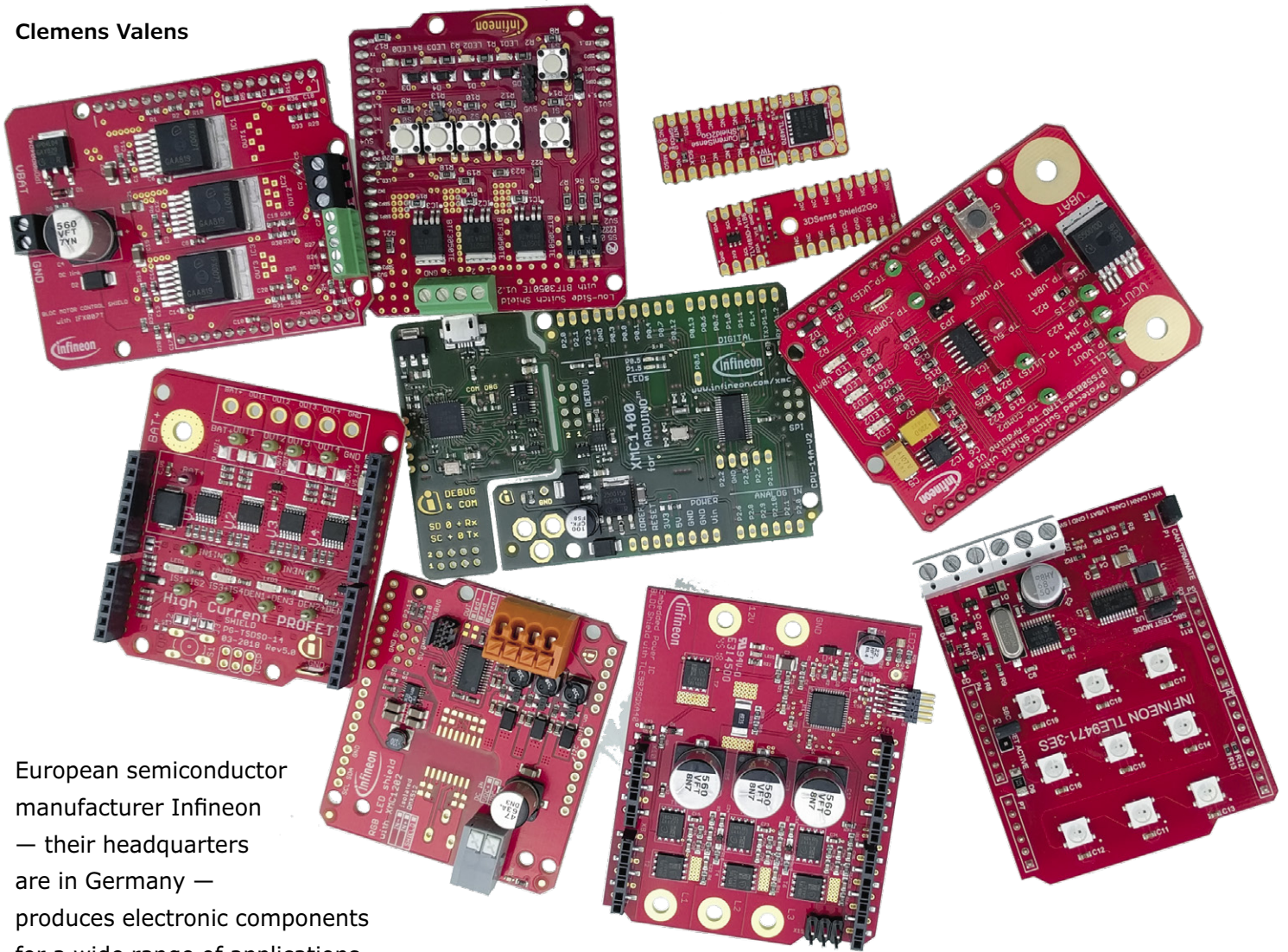


Having Fun with Development Boards from Infineon

Clemens Valens



European semiconductor manufacturer Infineon — their headquarters are in Germany — produces electronic components for a wide range of applications.

Evaluation and development boards supporting these devices ease the life of design engineers. Now that Arduino has become the de facto standard for fast prototyping tools, Infineon too has created a line of Arduino Shields. Let's have a look at a few of those.

Infineon for makers

If my memory is accurate, it was during an Infineon presentation that I first saw 'Makers' as a target audience on a slide during a presentation at a professional electronics trade show. These were no idle words and since then they have been busy developing Arduino-compatible evaluation boards ('Shields') for their components. Since Infineon specializes in automotive and power electronics, and digital security, it will come as no

surprise that these boards revolve around these application domains. Respecting common maker-scene conventions, the shields are supported by open-source Arduino libraries published at GitHub and the hardware designs are available as Eagle files. Besides Arduino-compatible products, more traditional tools exist as well. For the serious Infineon microcontroller application programmer there is the free, Eclipse-based DAVE with tons of example code.

Robust microcontrollers for industrial and automotive applications

Because microcontroller units (MCUs) are at the heart of most applications today, Infineon supplies them too. Their multicore Aurix family is intended for high-security and computation intensive automotive and other applications while the XMC line mostly targets industrial and lighting. Having 32-bit ARM cores, the “XMCs” are rather suitable for makers: the XMC1000 series have Cortex-M0 cores, XMC4000 devices have a Cortex-M4 core. Some specialized parts with a Cortex-M3 core exist also. Besides the standard peripherals — note that at Infineon a USART is called a USIC and a CCU hides a timer/counter (with lots of PWM options and capture/compare) — these MCUs offer advanced PWM functions for motor control and lighting applications. Some even feature a CORDIC engine for fast trigonometric calculations together with a 32-bit hardware divider. The XMC4300 and XMC4800 devices also integrate EtherCAT for real-time control automation over Ethernet.

Currently the XMC1000 family comprises four product lines:

- **XMC1100** – general-purpose;
- **XMC1200** – LED lighting and human-machine interface (HMI) applications;
- **XMC1300** – motor control and digital power conversion, but also features peripherals for LED lighting applications;
- **XMC1400** – the most powerful of the Cortex-M0-based devices, combines the capabilities of the XMC1200 and XMC1300 devices.

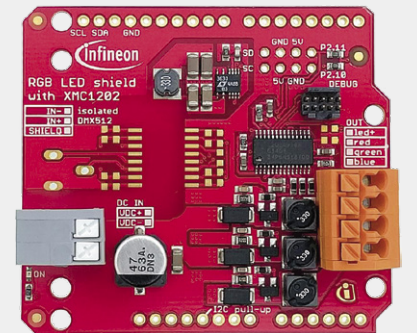
Control power with high- & low-side switches

A high-side switch connects a load to the positive side of a power supply whereas a low-side switch sits between the load and ground. High-side switching is preferable for switching heavy

RGB LED Lighting Shield with XMC1202

To be precise, this shield features an XMC1202-TO28X0016 microcontroller. It integrates a 9-channel ‘Brightness and Colour Control Unit’ (BCCU), a peripheral that enables flicker-free LED dimming and colour control through pulse density modulation (PDM). The shield can drive up to three LED channels with constant current. The buck converter providing this current can be simulated online. This shield is supported by almost two dozen software examples.

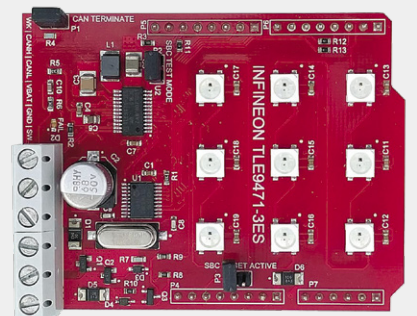
www.infineon.com/cms/en/product/evaluation-boards/kit_led_xmc1202_as_01/



DCDC System Basis Chip Shield with TLE9471-3ES

The TLE9471-3ES shield is built around a so-called DCDC System Basis Chip (SBC) and sports nine WS2812B addressable RGB LEDs, a CAN bus, and a high-side switch with fly-back diode capable of switching (inductive) loads up to 2.5 A. The buck converter powering the LEDs, the CAN bus and the high-side driver are all integrated in the TLE9471 SBC. Communication between the SBC and the baseboard is over SPI. To program the SBC a graphical configuration tool is available that spits out the necessary code for use with for instance Arduino. Thanks to the wide variety of on-board peripherals, this shield is a good platform for simulating car electronics.

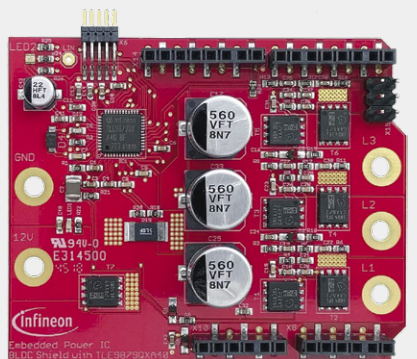
www.infineon.com/cms/en/product/evaluation-boards/sbc-shield_tle9471/

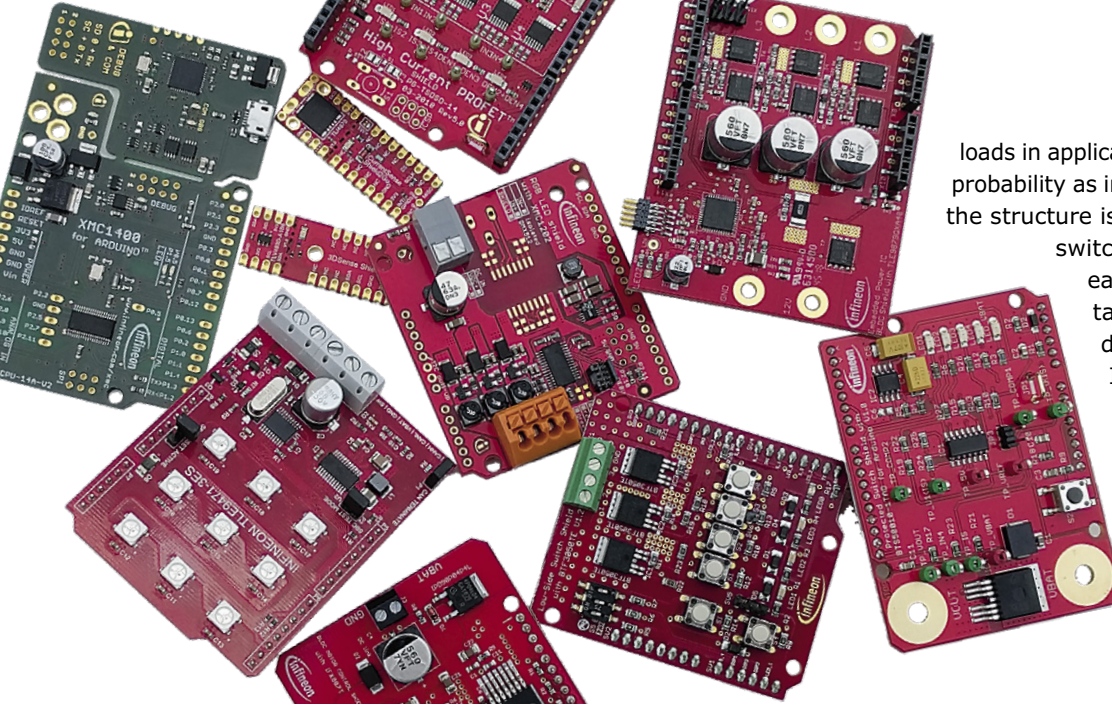


BLDC Shield with TLE9879QXA40

Member of the Embedded Power Microcontroller Boards family, this shield is equipped with a TLE9879QXA40, a three-phase motor driver with an integrated ARM Cortex-M3 core. The IC is assisted by six IPC90N04S5-3R6 power transistors each capable of passing 90 A (with proper cooling, the shield itself is specified for a maximum output current of 10 A). An RGB LED is present on the board too. The MCU comes preprogrammed with three motor control algorithms: sensorless Field-Oriented Control (FOC); back EMF and Hall-sensor-based block commutation. An Arduino-compatible baseboard communicates with the TLE9879 over SPI and lets the user change the parameters of the motor control algorithms. Up to four of these shields can be stacked on one baseboard. Example software for Arduino and µVision can be downloaded from the shield’s webpage.

www.infineon.com/cms/en/product/evaluation-boards/bldc_shield_tle9879/





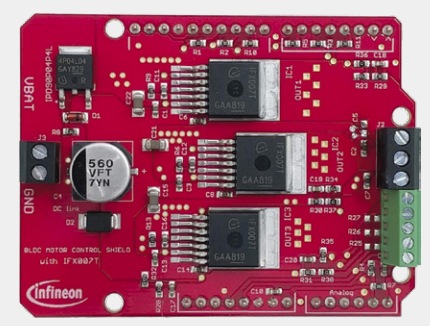
loads in applications with a high short-to-ground probability as in cars or machines where most of the structure is connected to ground. Low-side switches tend to be cheaper and are easier to control, making them suitable for switching light loads and doing PWM control.

Infineon makes a wide range of both high- and low-side switches. The high-side family is based on what they call "PROFET" technology, which stands for PRO-protected FET. These devices target automotive and industrial applications and can switch currents up to 40 A and volta-

(BL)DC Motor Driver IFX007T Shield

Power MOSFETs are very common in brushed and brushless (BL) DC motor drivers. Infineon has this domain covered with all sorts of parts but due to the limited space available, we will only highlight the (BL)DC motor driver IFX007T Shield. This is a kind of opposite of the TLE9879QXA40-based shield mentioned elsewhere in this article. Instead of an intelligent device running fancy algorithms all by itself, this is a discrete design based on three IFX007T high-current integrated half bridges. The board can control both brushless and brushed DC motors up to 300 W continuous load. The shield has several operating modes, to be activated with a soldering iron by reconfiguring some resistors; the baseboard, an Arduino Uno for instance, must provide the brains. This way of doing things allows connecting Hall sensors for sensor-based control, or, on the other hand, implement sensorless Back EMF or space vector modulation algorithms.

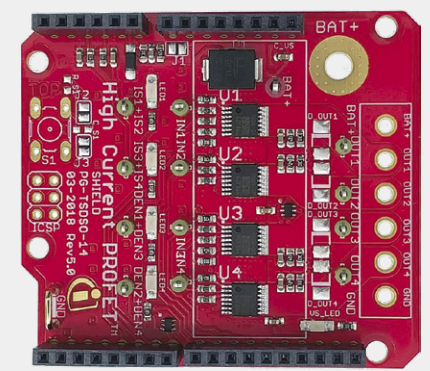
www.infineon.com/cms/en/product/evaluation-boards/bldc-shield_ifx007t/



High-Side Switch Shield with BTS700x-1EPP

An interesting family of shields is formed by the four-channel BTS700x-1EPP high-side switch shields where 'x' is '2', '4', '6' or '8'. The lower the number, the higher the current they can switch (resp. 20 A, 15 A, 12.5 A and 10 A). Only a check box on the packaging tells you which device is mounted on the board; the boards themselves are not marked. Targeted at high current automotive applications, the switches can be used for relay and fuse replacement, to control and protect outputs of a 12-volt supply, switch loads and measure the load current, and detect no-load conditions.

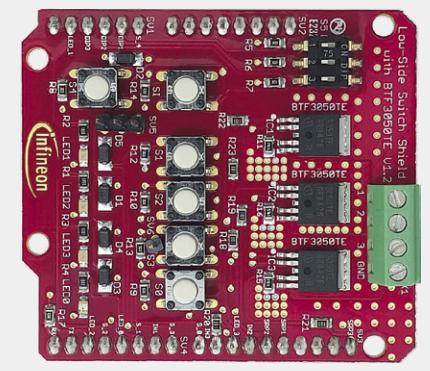
www.infineon.com/cms/en/product/evaluation-boards/shield_bts7002-1epp/
www.infineon.com/cms/en/product/evaluation-boards/shield_bts7004-1epp/



Low-Side Switch Shield with BTF3050TE

For experimenting with low-side switches the BTF3050TE-based shield with its three channels is a good candidate. Each channel can handle resistive, capacitive and inductive loads up to 3 A DC nominally and provide overvoltage, overcurrent, and overtemperature protection. PWM is supported as well (up to 14 kHz). The on-board pushbuttons and LEDs are practical for creating a basic user interface for your application. Example software for Arduino as well as DAVE is available.

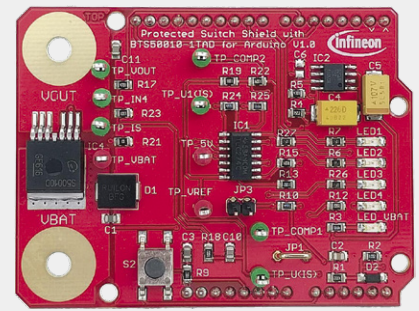
www.infineon.com/cms/en/product/evaluation-boards/shield_btf3050te/



12V Protected Switch Shield with BTS50010-1TAD

The BTS50010-1TAD high-side switch is an N-channel device with an on resistance of 1 mΩ and capable of delivering 40 A. It can be controlled directly from a microcontroller running at 3.3 V or 5 V. Built-in protections include loss-of-ground and loss-of-load detection, over- and undervoltage protection, overcurrent protection, reverse polarity, and thermal protection. An integrated output clamp makes the addition of an external flyback diode unnecessary. A sense pin allows for monitoring the load current and detecting faults.

www.infineon.com/cms/en/product/evaluation-boards/shield_bts50010-1tad/



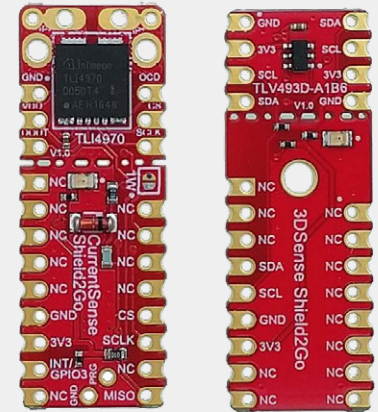
Shield2Go TLV493D and TLI4970

The TLV493D is a 3D magnetic sensor that measures linear motion and rotation in three dimensions. Applications include joysticks and other control elements, anti-tampering and any other application that requires accurate angular measurements. It also integrates a temperature sensor.

www.infineon.com/cms/en/product/evaluation-boards/s2go_3d-sense_tlv493d/

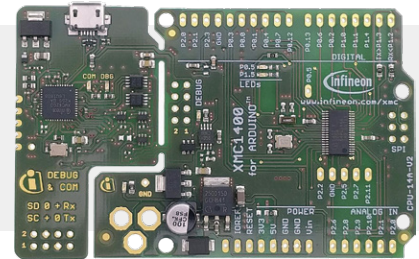
The TLI4970 is a coreless magnetic AC/DC current sensor capable of measuring currents up to ±50 A with a resolution of 12.5 mA (13 bits) and an SPI interface. Hand-soldering this device is difficult, making this Shield2Go a handy breakout board. Although the sensor may seem like a pretty simple device, it isn't as it integrates a DSP with ADC and digital filter, overcurrent detection, an EEPROM, a temperature sensor, and a mechanical stress sensor.

www.infineon.com/cms/en/product/evaluation-boards/s2go_cur-sense_tli4970/



XMC for Arduino

Arduino-compatible development boards exist for XMC1000 and XMC4000 devices. As examples we can mention the 'XMC1400 for Arduino' and the very similar 'Boot Kit XMC1100'. These boards are supported by the Infineon Boards Package for Arduino so the user can program them through the Arduino IDE.



The Infineon boards presented in this article are available in the Elektor Store!

ges up to 28 V. Internally they integrate an N-FET with all sorts of protection circuits and a charge pump, allowing a microcontroller to control them directly. Infineon's low-side switches use "HITFET" technology (Highly Integrated Temperature protected FET). Their main playground is automotive applications where they control lights, heaters, relays and small motors.

Evaluate sensors with Shield2Go

Infineon is active on multiple fast prototyping fronts. Shield2Go is their own approach of such a platform. It consists of a family of breadboard-friendly tiny breakout boards (39 × 15 mm) with a standardized pinout. Each board is equipped with a different sensor or a security IC; there is also a board with an XMC1100 microcontroller ('XMC 2Go'). The "chip-of-interest" is placed on one end of the board that can be broken off. Thus, the user can first try out the IC on a breadboard and, when ready, break off the chip to build it into a device without

consuming too much space. Instead of connectors, the boards are furnished with clamping pin headers to use them without requiring any soldering. The 'My IoT Adapter' board bridges the gap to Arduino-compatible platforms like Infineon's own Boot Kits. With this adapter up to three Shield2Go boards can connect to a baseboard. Arduino libraries for the Shield2Go boards are available at GitHub. ◀

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Web Links

- [1] Infineon for makers: www.infineon.com/makers
- [2] Infineon at GitHub: <https://github.com/Infineon>