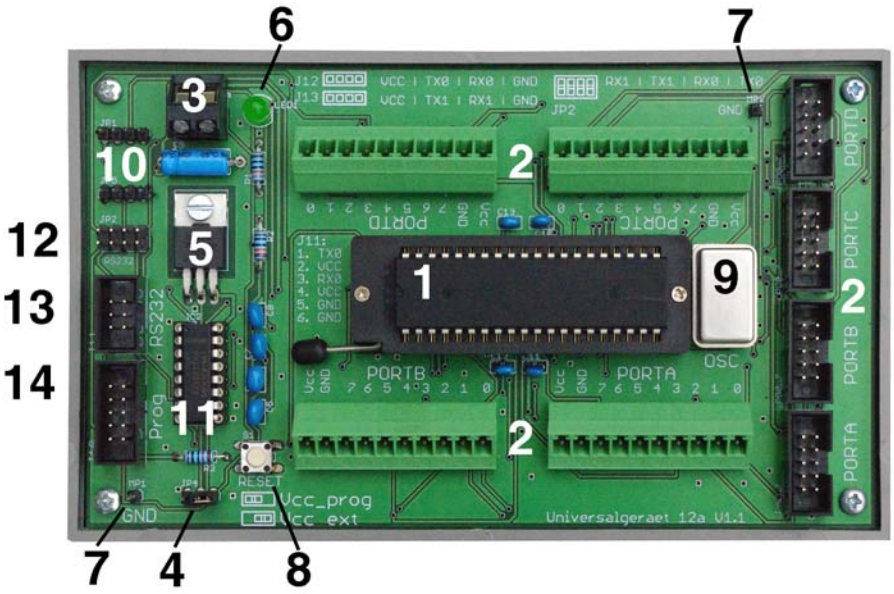
General-Purpose Microcontroller Module 12a
Hardware Reference

Release 1.4 (June 14, 2016)

Purpose:
General-purpose platform to accommodate an Atmel ATMega microcontroller. Application-specific circuitry can be attached via pin headers and terminal strips. Depending on the microcontroller inserted, the module supports up to two serial interfaces, both with RS-232 and one with 5-V signalization. Via these interfaces, the module can be integrated into multiprocessor systems. It can be used as an OEM building block by selectively inserting appropriate components.

- PCB dimensions: approx. 92 by 156 mm (approx. 4" by 6 6,3").
- PCB fits on a sloped enclosure TEKO 362 and on frames for DIN rail mounting.
- Supply voltage: 5 V or less, depending on components inserted.



1	Microcontroller	8	Reset key
2	I/O connectors	9	Clock generator
3	Power supply	10	RS-232 attachment
4	Power supply jumper	11	RS-232 signalization
5	Antireversal protection	12	RS-232 configuration
6	Power LED	13	Header for serial 5-V signalization
7	Ground test points	14	Programmer / SPI header

Fig. 1 The general-purpose microcontroller module 12a.

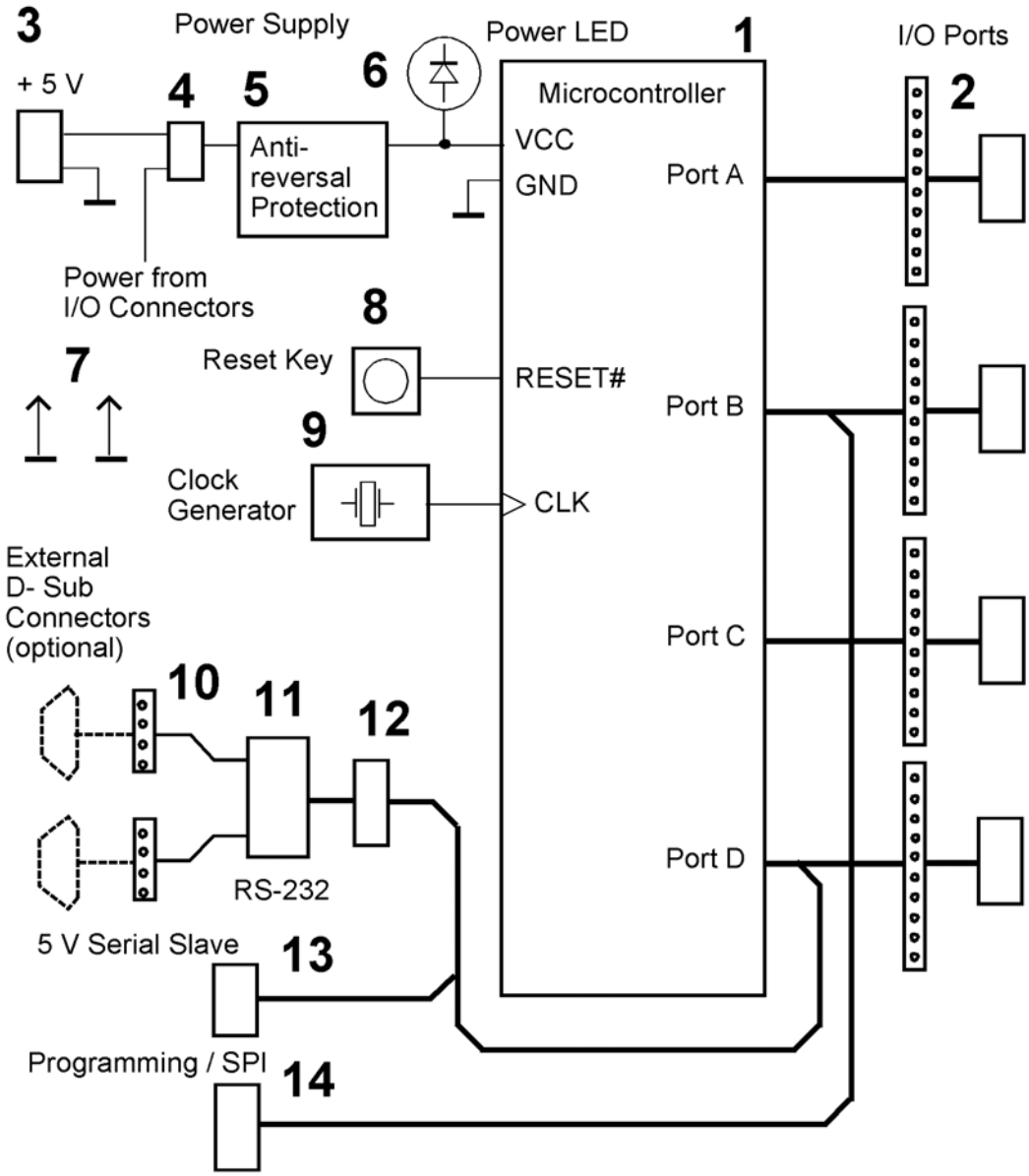


Fig. 2 General-purpose microcontroller module 12a block diagram.

Microcontroller (1)

The board can accommodate any Atmel ATmega microcontroller in a dual inline package (DIP) with 40 pins, provided the power supply pins are in the center. It is possible to chose between different types[1]; ranging from greatest simplicity (for example, ATmega16) up to a maximum number of features and memory capacity (for example, ATmega1284). Around the holes, enough space has been left to allow for insertion of a ZIF socket, thus enabling fastest processor swapping.

I/O connectors (2)

All I/O signals of the microcontroller are accessible (ports A, B, C, D). Various connector types can be inserted. The board provides for pin headers and terminal strips. Each port has its own

1: Inter alia ATMega 16, 164A, 324A, 644A, and 1284.

connectors. The pin pitch is 2,54 mm (100 mil) for pin headers and 3,81 mm (150 mil) for terminal strips. The pin assignment of the headers corresponds to the industry standard of the Atmel starter kits and the like. Each port connector provides GND and VCC contacts, which can be used to power external circuitry or to feed the module. Depending on the connectors, other modules can be attached via cables or stacked. In Fig. 1, a somewhat luxury type of terminal strip is shown, manufactured by Phoenix Contact. Table 1 shows different connector types. The application wiring ends in pluggable screw terminals. Hence the wires can be disconnected with little effort.

To be soldered in	Base strip - SMC 1,5/10-GF-3,81 - 1827509 sloped (as shown in Fig. 1) Base strip - MCV 1,5/10-GF-3,81-LR - 1818261 vertical Printed-circuit board connector - MC 1,5/10-GF-3,81-LR - 1817880 horizontal
Removable screw terminals	Printed-circuit board connector - MC 1,5/10-ST-3,81 - 1803659 without fastening screws Printed-circuit board connector - MC 1,5/10-STF-3,81 - 1827787 with fastening screws Printed-circuit board connector - MCVR 1,5/10-ST-3,81 - 1827208 vertical

Table 1 Some Phoenix Contact connectors.

Power Supply (3)
Power must be supplied from outside. The board has no voltage regulator. Convenient power sources are a 5-V or 3.3-V power supply unit, a 3.7-V or 4.8-V battery[2], or (via an external adapter) the USB. Power can be fed into the module via the power connector (terminal block) or any other connector with VCC and GND pins. The other way round, all interface connectors with such pins can be used to power the attached circuitry.

Notes:
1. If the module is to be operated with less than 4.8 V, it may be required to insert components appropriately specified for low voltages. This relates especially to the crystal clock generator and the RS-232 level converter.
2. The high level of serial signalization (13) corresponds to the power-supply voltage.

Power Supply Jumper (4)
This jumper selects the power source. Power can be fed via the terminal block or any other connector with VCC and GND pins. Fig. 3 illustrates how the power configuration is to be set:

a) No Jumper at all. Power will be delivered via the I/O or serial connectors, respectively.

b) Jumper to the right. Power will be delivered via the power-supply connector (terminal block).

2: 1 cell Li-ion or 3 or 4 cells 1.2 V.

c) Jumper to the left. The power rail is connected to the power contacts of the SPI/Programmer header. The module will be fed from the programmer or the external SPI device.

d) A special jumper with three contacts is necessary if the power is to be delivered via the power-supply connector (terminal block) and if a programmer or external SPI circuitry is to be powered from the module.

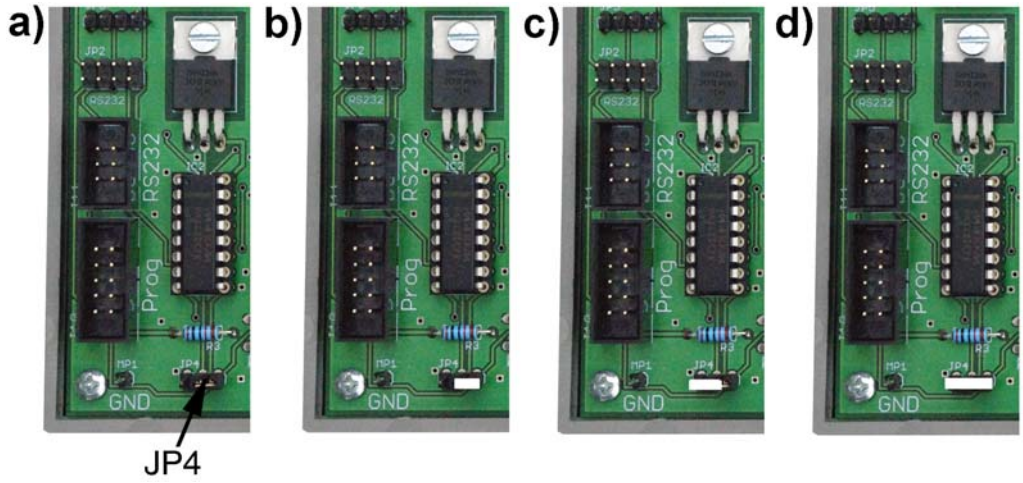


Fig. 3 Power Supply Configuration (Jumper JP4).

Antireversal Protection (5)
The venerable circuit invented by Bob Pease protects the module against polarity reversal.

Notes:

1. Antireversal protection is effective when power is supplied via the terminal strip (3) or the programmer/SPI header (10). There is no protection when power is supplied via the other I/O headers[3].
2. The antireversal protection depends on a P-channel FET with low R_{DSon} and low V_{GTH}. If the voltage drop cannot be tolerated, antireversal protection is to be abandoned. In this case, do not insert a FET, but a jumper wire from drain to source. The problem may occur especially in case of low voltage operation (e.g., 3.3 V).

Power LED (6)
One of the most basic troubleshooting aids is an indication, whether a device is powered or not.

Ground Test Points (7)
Two ground test points can be inserted to support oscilloscope attachment and the like.

Reset Key (8)
As experience shows, a reset key is an inexpensive, but convenient means to facilitate debugging and troubleshooting.

3: Because it is assumed that the device providing the power will energize the interface cables with right polarity.

Clock Generator (9)
A complete crystal clock generator can be inserted. This allows to operate the microcontroller up to its maximum clock frequency.

RS-232 Attachment (10)
RS-232 signals are to be attached via pin headers (Fig. 4a, b). The VCC and GND pins can be used to power external circuitry or to feed the module. If the VCC contact is not needed, a pin header with only three contacts (TX, RX, GND) can be inserted. In a typical configuration, an industry-standard D-sub connector is attached via wire and an appropriate plug.

RS-232 Signalization (11)
There are microcontrollers with one UART or with two. The board supports up to two serial ports with RS-32 signalization. Level conversion is done by a MAX232 converter IC.

RS-232 Configuration (12)
The RS-232 connections are made by jumpers (cf. Fig. 4c). So they can be disconnected easily, if the application has no need for serial communication, freeing the microcontroller port signals for another use.

Header for serial 5-V signalization (13)
This header (cf. Fig. 4a) is connected to the first UART. In the module family, there are two pin assignments, one for the slave or upstream connection and one for the master or downstream connection. This module is configured for slave attachment, downstream of a personal computer, a master controller, an USB to serial converter, or a hub (active or passive). The header comprises VCC and GND pins. They can be used to power external circuitry or to feed the module (Fig. 5 shows an example). The serial signals are directly connected to the microcontroller. If the application has no need for serial communication, the microcontroller port signals are free for another use. The header may be omitted.

Note: The high level of serial signalization (13) corresponds to the power-supply voltage. In the proper sense, the term 5-V signalization is valid only in case of 5-V supply.

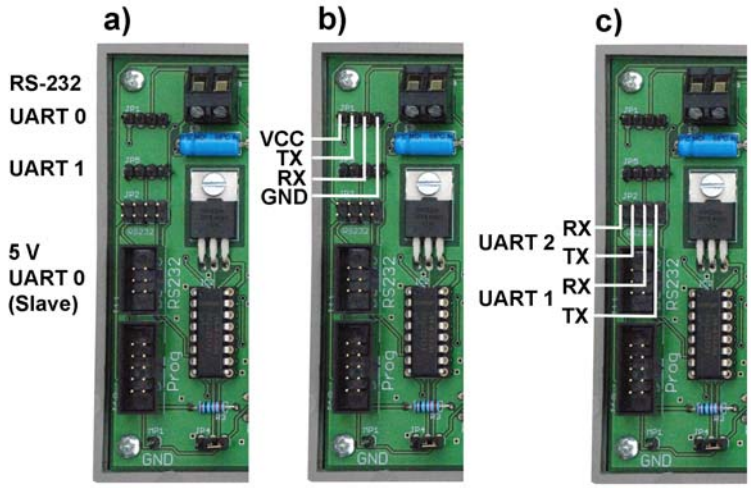


Fig. 4 RS-223 attachment. a) Connectors. b) Connector assignment. c) RS-232 configuration jumpers.

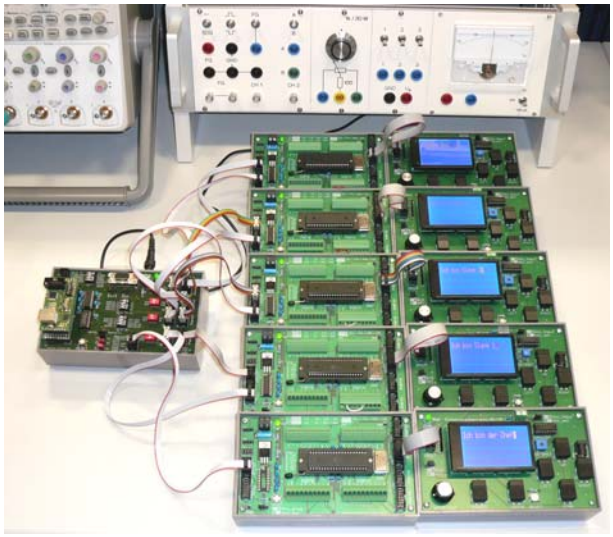


Fig. 5 Powering modules via 5 V serial connections. In this experimental multiprocessor configuration, the modules are fed from the passive hub, which is in turn connected to a wall adapter.

Programmer / SPI Header (14)

The board allows for inserting a header with 6 or 10 pins, respectively. The assignment of the 6 pins corresponds to that of the industry-standard Atmel programmers. The larger header provides additional signals to support attachment of SPI devices like ethernet controllers, USB host controllers, or serial memories. If such a header is inserted, programmers are to be connected via a special ribbon cable (Fig. 6). The header comprises VCC and GND pins. They can be used to power external circuitry or to feed the module. The VCC rail connection is controlled via jumper JP4 (cf. Fig. 3).

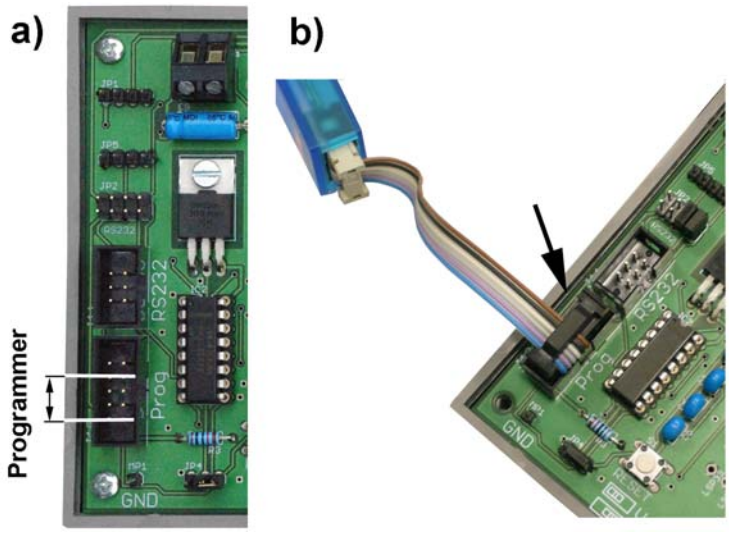
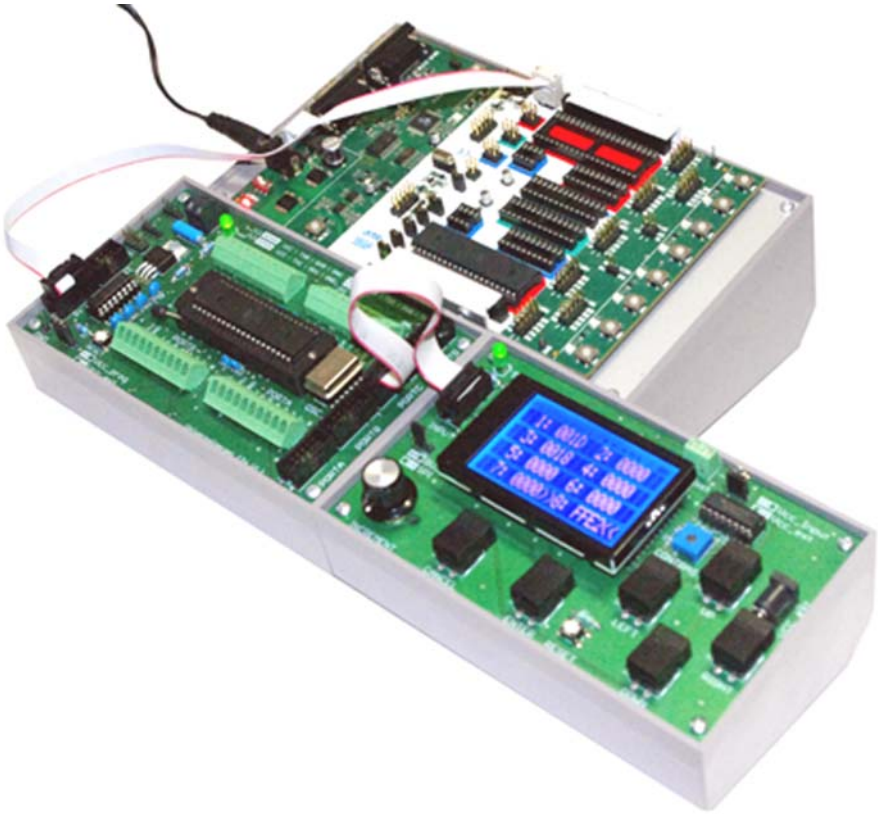


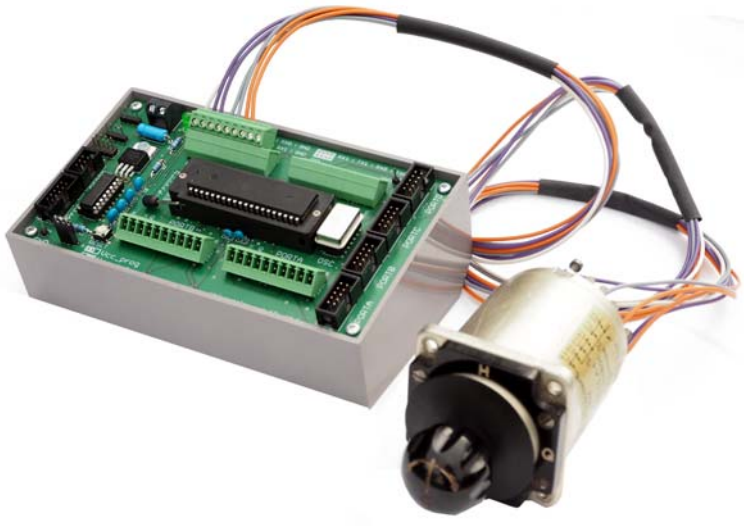
Fig. 6 The SPI/Programmer header. a) Programmer attachment requires only 6 pins. b) Special adapter cable 6 to 10 pins.

Microcontroller Module 12a in Action
– A Photo Gallery –

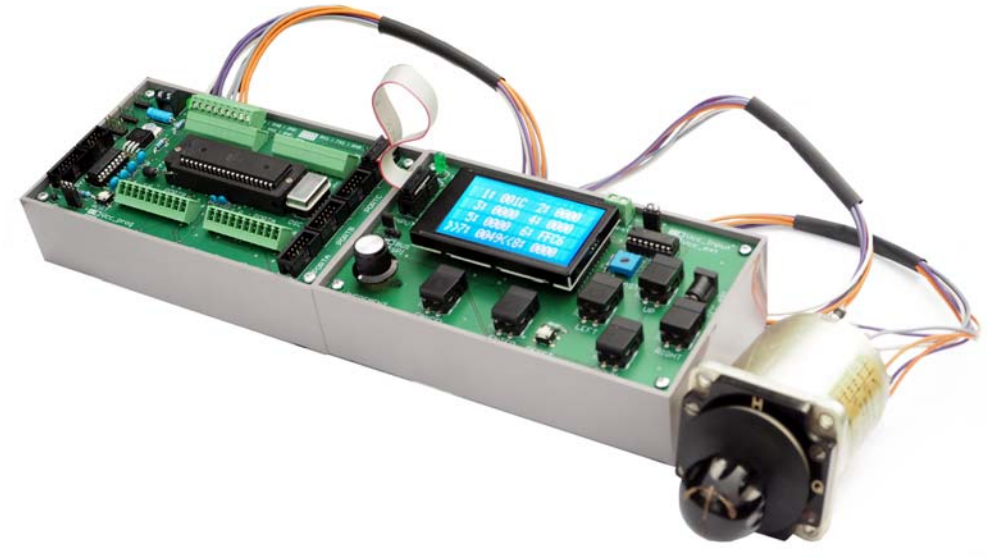
A microcontroller module is connected to a human interface module. An Atmel STK500 starter kit serves as programmer and power supply. This is a typical setup for experimental or educational use.



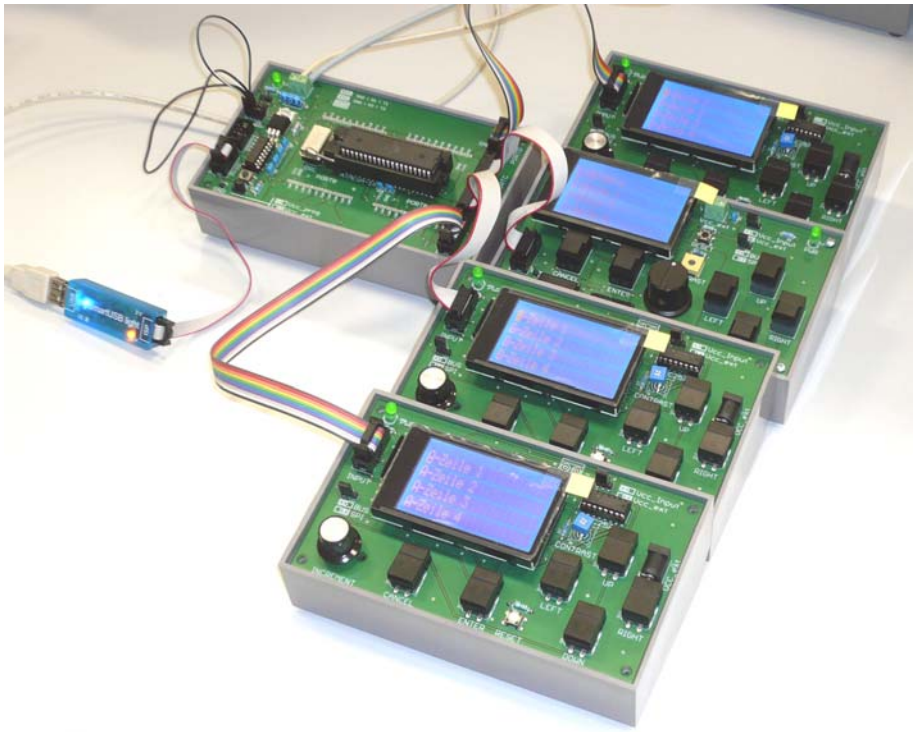
A historical joystick is attached to a microcontroller module (try this with one of the ubiquitous low-cost boards ...).



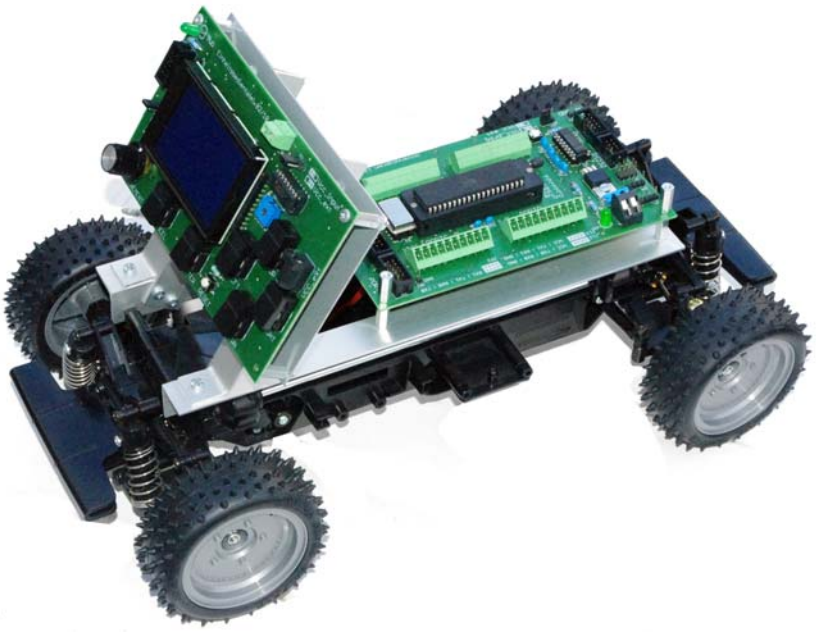
A human interface module visualizes joystick actuation.



A microcontroller module supports four human interface modules. This ist an educational setup to demonstrate principles of multitasking.



An educational model vehicle shows that the modules can be used as OEM building blocks, too. The purpose of this contraption was to build a platform to facilitate beginners's experiments with robotics. Compared to the ubiquitous small robots on wheels, it should be more sturdy and provide ample expansion space.



The PCB dimensions are well suited to mount modules on a DIN rail. This educational system comprises a microcontroller module, a human interface module stacked above, and an LCD module, carrying a graphical LCD display.