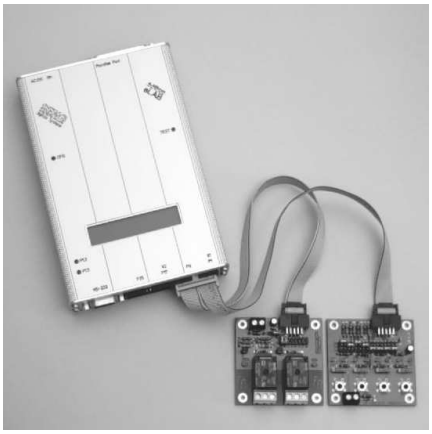
eLAB



Module based, all programmable laboratory for prototyping, testing and training.

- (C)PLD, FPGA, 8051, AVR, ...
- C, VHDL, Verilog, state-machines, ...
- open system, scalable, durable, low-budget

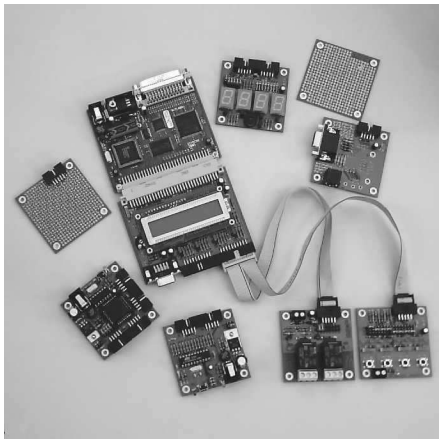
Replace soldering, single semiconductors and the classical breadboard by programmable and reconfigurable standard semiconductors. Explore the world of electronics and computer science by using ´eLAB´ modules, a PC and lots of free and industrial established software. Develop circuits using schematic entry, state-diagrams or hardware description languages such as VHDL or Verilog using PC based software. Download results to ´eLAB´ modules. From the simple logic AND circuit and Flip-Flop to the reconfigurable computer, into the world of C- and HDL-programming.

On the base of our all programmable dlk51 development platform we offer a system usable for development and training purposes. The system, based on industry standards, is almost unlimited expandable and combinable. Available base components are (C)PLD, microcontroller and FPGA . Programmability and modular expandabilities of the system permit an extreme application range, at minimum costs. **Development software and source code are available for free.**

Hardware

The ´eLAB´ system is module based. The modules are classified into active and passive modules.

Active modules are autonomously bootable and contain a (C)PLD, an FPGA or a microcontroller as well as a power supply.
Passive modules carry peripherals e.g. displays, switches, relays, keyboard connections, integrated circuits, prototype boards etc.



Modules are connected via flat cables. Each module possesses at least one 10-pin header (2x5 pins, 2,54mm / .100" centers, DIN41651). A ´eLAB´ link includes 8 data signals, ground and power-supply.

The number of existing modules is constantly increasing, modules can be connected and combined in variously ways. The system does not depend on a certain CPU-type, buswidth or semiconductor.

A privileged position within active modules takes the eLABbase-module. Additionally to standard features it contains a parallel interface to the PC, an FPGA with four full programmable ´eLAB´ ports (4 x 8 bits and power-supply), a CPU with serial RS-232 interface and a 16x2 LC-display (optional). ´eLABbase´ consists of the all programmable ´dlk51´ development platform, the eLAB2dlk51-adapter attached to it (with optional LC-display) and a housing (optional). The size of the module with housing is 178x114x32mm (LxWxH). Programming of active eLAB modules is done via ´eLABbase´.

SENG digitale Systeme GmbH • Innovative FPGA based systems. • Im Bruckwasen 35 • D-73037 Goeppingen • Germany
tel +49 7161 75245 • fax +49 7161 72965 • eMail info@seng.de • internet http://www.seng.de • flyer version 2005-01-14

eLAB - laboratory for electronics / computer sciences

SENG

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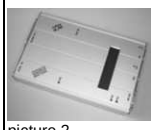
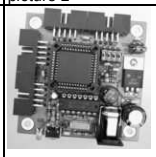
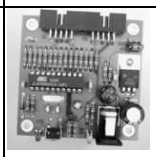
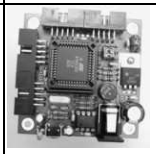
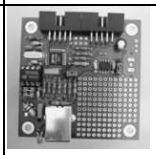
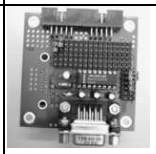
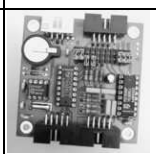
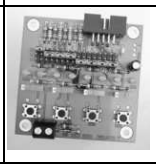
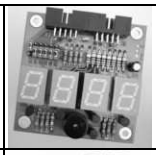
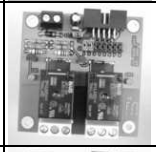
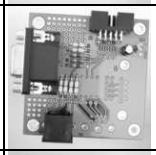
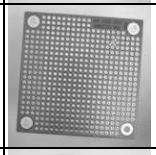
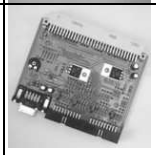
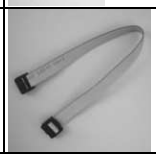
Module overview: (modules of the following table are assembled and tested and/or as bare printed circuit board available, price-list see: http://www.seng.de/pricelist_.html)

Function Name, Type	Module - Description	Picture
eLABbase eLABbase, active	• FPGA, CPLD, 8051 CPU with serial RS-232 interface and 512 KBytes Flash-memory for programs and configuration data • parallel interface to the PC (500 KBytes/sec) for system management and data transfer • three all programmable (FPGA based) ´eLAB´ links (8 bits I/O and 3V3 or 5V power supply, selectable via jumper) • one all programmable (FPGA based) ´eLAB´ link (6 bits I/O, 2 bits input and 3V3 or -1V9 power supply, selectable via jumper) • select-switch for FPGA configuration file A/B • sub-D9 female connector for serial RS-232 interface of ´dlk51´ • optional: LC-display with 2 lines x 16 characters, housing • ´eLABbase´ consists of the all programmable ´dlk51´ development platform, the eLAB2dlk51-adapter attached to it (with optional LC-display) and a housing (optional) • size of module with housing: 178x114x32mm (LxWxH) • programming of active ´eLAB´ modules is done via ´eLAB´ link of ´eLABbase´. Emulation mode for XILINX JTAG programming cable (DLC5 / Parallel Cable III compatible). Emulation mode for ATMEL AVR ISP Dongle (STK200 / STK300 compatible) • picture 1: eLABbase with LC-display (optional), without housing (optional) • picture 2: eLABbase with LC-display (optional), with housing (optional)	 picture 1  picture 2
CPLD, xc9572xl eMOD-d, active	• CPLD, type Xilinx xc9572xl, PLCC44 socket • 3 x ´eLAB´ link (8 x I/O, VCC, GND) • 1 x ´eLAB´ link (8 x I/O, VCC, GND) or (4 x I/O + JTAG program port, VCC, GND). Selectable via jumpers • optional: JTAG interface, 6-pin header (.100" centers, DIN41651) • power supply AC/DC via integrated 3V3 power supply with plug DIN45323 (optional: screw clamp) or ´eLAB´ link. Selectable via jumper • crystal oscillator 4MHz • 1 x pushbutton-switch for reset or input • 1 x LED	
AVR microcontroller, AT90S2313 or ATtiny2313 eMOD-k , active	• MCU, type AT90S2313 or ATtini2313, DIP20 socket • installed MCU: AT90S2313, supply voltage 3V3 • 1 x ´eLAB´ link (PD0..PD6, (optionally: PB4), VCC, GND) • 1 x ´eLAB´ link (PB0..PB7, VCC, GND) or (PB0..PB3 + ISP interface, VCC, GND). Selectable via jumper • optional: 6-pin header (.100" centers, DIN41651) for ATtini2313 (PA0..PA2) • power supply AC/DC via integrated power supply with plug DIN45323 (optional: screw clamp) or ´eLAB´ link. Selectable via jumper • crystal 4MHz • 1 x LED connected to PB3 or PB4 via jumper • 1 x pushbutton-switch for reset or input at PB3 or PB4. Selectable via jumper • optional: 6-pin header (.100" centers, DIN41651) for Atmel ISP plug	
8051 / AVR Microcontroller, AT89xx or ATmega8515 eMOD-n, active	• MCU, type 8051 or AVR with 8051 pinout, PLCC44 socket • board can be used for a variety of 8051 style MCU´s and supply voltages • installed MCU: AT89S53, supply voltage 5V • 3 x ´eLAB´ link (P0.0..P0.7, VCC, GND), (P2.0..P2.7, VCC, GND), (P3.0..P3.7, VCC, GND) • 1 x ´eLAB´ link (P1.0..P1.7, VCC, GND) or (P1.0..P1.3 + ISP interface, VCC, GND). Selectable via jumper • power supply AC/DC via integrated power supply with plug DIN45323 (optional: screw clamp) or ´eLAB´ link. Selectable via jumper • crystal 12 MHz • 1 x LED connected to P1.3 or P1.4 via jumper • 1 x pushbutton-switch for reset or input at P1.3 or P1.4. Selectable via jumper • reset-controller • optional: 6-pin header (.100" centers, DIN41651) for ISP plug	
USB FIFO eMOD-p, passive	• FTDI USB FIFO FT245BM. Alternative: USB UART FT232BM • USB connector type B • eePROM configuration memory for FTxxxBM • power supply via USB-bus oder ´eLAB´ link • 2 x ´eLAB´ link (D0..D7, VCC, GND), (/RD, WR, /TXE, /RXE, SI/WU, /PWREN, /RSTOUT, /RESET, VCC, GND). 5V or 3V3 compatible logic-interface, configuration via jumper • power out with MOSFET switch, controlled via FTxxxBM, via jumper connectable to VCC pins of ´eLAB´ link. Optional: 2-pin screw clamp • prototype area	
RS-232 tranceiver eMOD-o, passive	• RS-232 tranceiver, 2/1-channels • board can be used for MAX(3)232 / MAX(3)222 (with shutdown) • installed tranceiver: MAX3232, 3...5V power supply • configuration: 2 x RS-232 with RD and TD or 1 x RS-232 with RD and TD and RTS and CTS. Configuration via jumpers • crossing of RD-TD, RTS-CTS via jumpers • D-sub connector 9-pins, female, for RS-232, PC-compatible. Alternative: 10-pin header (.100" centers, DIN41651) • optional: D-sub connector 9-pins, female, for RS-232, PC-compatible or 10-pin header (.100" centers, DIN41651) • 2 x ´eLAB´ link (8 x I/O, VCC, GND), configuration of I/O allocation via jumpers • power supply via ´eLAB´ link	
i2c module with real-time clock, digital I/O and analog I/O eMOD-e, passive	• 1 x ´eLAB´ link (8 x I/O, VCC, GND), configuration of I/O allocation (i2c-bus and interrupts) via jumpers • power supply via ´eLAB´ link • 1 x real time clock PCF8583P, lithium backup battery, interrupt output • 1 x 8-bit AD/DA converter PCF8591P (4 analog inputs, 1 analogue output), ´eLAB´ port (4 x analog in, 1 x analog out, 3 x analog ground, VCC, GND) • 1 x 8-bit PIO PCF8574P, ´eLAB´ port (8 x I/O, VCC, GND), interrupt output • 1 x 6-pin header (.100" centers, DIN41651) for external i2c-bus, e.g. LM92 (or LM75) temperature sensor... • optional: 1 x eeProm, type 24c02, DIP8 socket • configuration of i2c-addresses via jumpers, several modules cascadeable	
LED's and pushbutton-switches eMOD-c, passive	• 1 x ´eLAB´ link (8 x I/O, VCC, GND) • 8 x LED • 4 x pushbutton-switches (optional: in parallel 4 x slide-switch) • 1 x screw clamp for speaker • configuration via jumpers: 8 x LED, 4 x LED lower nibble + 4 x pushbutton-switch upper nibble, 4 x LED upper nibble + 4 x pushbutton-switch lower nibble, 3 x LED upper nibble + 4 x pushbutton-switch lower nibble + speaker • power supply via ´eLAB´ link • inline mountable and cascadable	

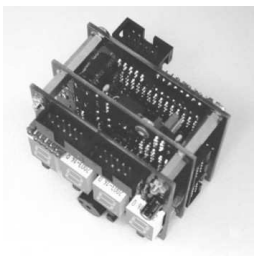
7-segment LED display with four digits, speaker eMOD-b, passive eMOD-l , passive	• 2 x ´eLAB´ link (8 x I/O, VCC, GND) • eMOD-b: 4 x 7-segment LED display with common anode • eMOD-l: 4 x 7-segment LED display with common cathode • 1 x speaker • configuration via jumpers • power supply via ´eLAB´ link • inline mountable and cascadable	
double power relais output eMOD-i, passive	• 1 x ´eLAB´ link (8 x I/O, VCC, GND), configuration of I/O allocation via jumpers • 2 x relais with SPDT (single-pole double-throw) contacts, 3-pin screw clamp and status LED, contact rating max. 10A/25V AC voltage or 5A/42V DC voltage • power supply via ´eLAB´ link or screw clamp for external power supply. Selectable via jumper	
VGA -, mouse-, keyboard-, miniDIN-, Sub-D9-Interface eMOD-f, passive	• 1 x ´eLAB´ link (8 x I/O, VCC, GND) • 1 x sub-D15HD female connector for VGA monitor/max. 640x480/max. 8 colors (max. 4 colors if mouse and keyboard are connected) • 1 x miniDIN socket, 6-pins (PS2) for mouse or keyboard connection, (3...8-pins optional) • optional: 1 x miniDIN socket, 6-pins (PS2) for mouse or keyboard connection, (3...8-pins optional) • optional: 1 x sub-D9 connected to pin header (.100" centers)	
prototype board eMOD-m, passive	• prototype board, double sided • material: FR4, 1,6mm (0.063") thick • grid holes spaced on 2,54x2,54mm (.1"x.1") centers • 479 plated thru holes, diameter: 1,7mm (70mil), drilling: 1,0mm (40mil) • solid copper plane on both sides, for the connection of e.g. VCC, GND • optional: 1 x ´eLAB´ port (8 x I/O, VCC, GND)	
adapter dlk51 - eLAB eLAB2dlk51	• three all programmable (FPGA based) ´eLAB´ links (8 bits I/O and 3V3 or 5V power supply, selectable via jumper) • one all programmable (FPGA based) ´eLAB´ link (6 bits I/O, 2 bits input and 3V3 or -1V9 power supply, selectable via jumper) • 3V3 and 5V voltage regulator with current limiting • charge pump for generating a negative voltage (-1V9) for the optional LC-display • select-switch for FPGA configuration file A/B • sub-D9 female connector, serial interface dlk51, RS-232 • series resistors for protection of FPGA I/O pins • optional: LC-display, 2 lines x 16 characters • size of adapter: 88x100x20mm (LxWxH) • can only be used in connection with dlk51 development platform	
housing eLABbase case-b	• housing, aluminium, prepared for assembling, prints on • size: 173x114x32mm (LxWxH) • opening for LC-display • extent of delivery: 2 profiles, 2 cover plates, screws bumpers • illustration: housing with installed eLABbase and LC-display (both do not belong to extent of delivery)	
cable - eLABbase cable-b	• 1 x connector female 20-pin (2x10, .100" centers) • 25cm (10") flat cable 2 x 10-conductors • 2 x connector female 10-pin (2x5, .100" centers)	
LC-display LCD-b	• LC-display, 2 lines x 16 characters • 3V3 compatible • backlight • size: 80x36x14mm • including mounting material and connector	
cable - eMOD cable-m	• 1 x connector female 10-pin (2x5, .100" centers) • 25cm (10") flat cable 10-conductors • 1 x connector female 10-pin (2x5, .100" centers)	

News and additional accessories see http://www.seng.de/eLab_hardware_.html

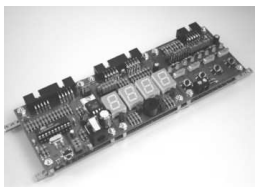
Mechanics

Based on a 2.54mm (.100") grid module size is 60.71 x 60,71mm (2.390" x 2.390"). Distance between mounting holes for 3mm screws is 50.80 x 50,80mm (2" x 2"). Modules are:

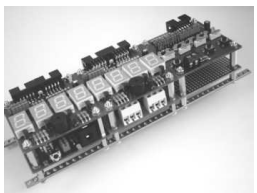
stackable



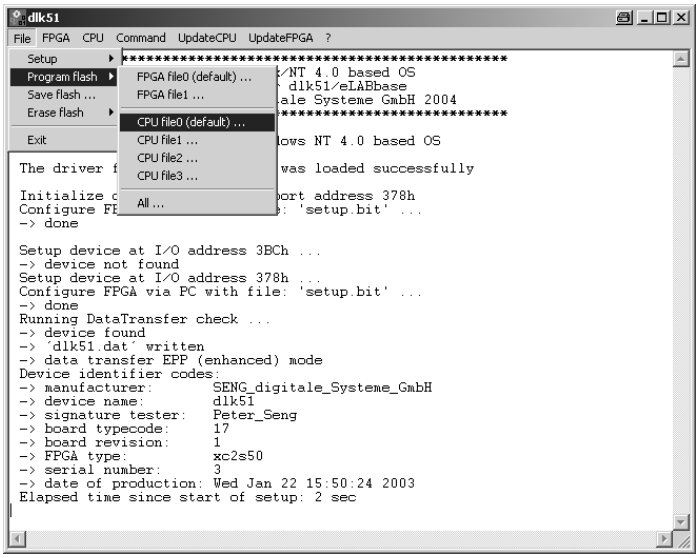
and inline



cascadeable



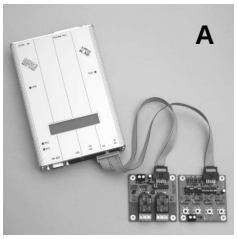
Software



- **Development environment ´dlk51´** for Win9x/NT4.0 based operating systems. Program for system administration of ´eLABbase´-module, including following functions: setup; FPGA-configuration; programming of internal Flash-memory (for CPU and FPGA); integrated command line interpreter (the easy way to include user code); emulation modes for ATMEL AT89isp cable, AVR ISP dongle and XILINX JTAG download cable (DLC5 / Parallel Cable III); support for INTEL MCS BASIC-52 interpreter. Program consists of user interface and a DLL containing all functions. Source code is available, program can be edited and extended by user.
- For programming of ´eLABbase´ internal devices (FPGA, CPLD and CPU), and ´eLAB´-modules (CPLD, CPU) powerful **professional tools** are available. Program packages are **available for free via internet**. These products are: XILINX **ISE WebPACK** (integrated software environment for programmable logic devices, simulation and programming tools, schematic entry, VHDL and Verilog compiler), **SDCC C Compiler** (for 8051 CPU´s), INTEL MCS BASIC-52 interpreter (for 8051 CPU´s), **WinAVR C-compiler** (for AVR CPU´s), **AVRstudio** (for AVR CPU´s - assembler, simulator), PonyProg (programming software for ATMEL AVR ISP dongle), AT89isp software (programming software for ATMEL AT89isp cable), **EAGLE light** (board layout and schematic software)

Applications and sources

- See our internet pages (http://www.seng.de/eLab_applications_.html) for applications, test- and demo-projects as well as **source-code** for all ´eLAB´-modules. From simple AND logic gate to the demanding VHDL projekt (24h real time clock in FPGA / CPLD, control of UART, LCD and several i2c-devices via 8051 ...)
- Schematic and PCB layout of ´eLAB´-modules is available in EAGLE format, see: http://www.seng.de/eLab_hardware_.html)
- Link-collection (database) to themes all around ´eLAB´, ´dlk´, FPGA´s, 8051, AVR, VHDL, IP-cores, soft-CPU´s, ... See: (http://www.seng.de/dlk_database.html)



Application examples

´eLABbase´ the core element of the ´eLAB´ system contains all elements (FPGA, CPLD, CPU, Flash-memory, PC-interface, power-supply, LC-display ...) necessary to build an autonomously bootable and all programmable system. Administration and access to internal ressources is done via ´dlk51´ software. For development of device internal programs and configuration files powerful professional tools are available for free. Peripherals combinable with ´eLABbase´ are availbale in form of ´eLAB´-modules or can be developped with minimal effort (example A, control unit). Thus almost arbitrary applications can be developed at minimum expenditure. Active ´eLAB´-modules (CPU, CPLD) can be used to extend the capabilities of ´eLABbase´, or to replace it, and serve as the applications core instead of it (example B, mini control system). It is also possible to switch from ´eLABbase´ to an active ´eLAB´-module after initial application development, to downsize price and not needed performance. Active ´eLAB´-modules are programmed using ´eLABbase´. The system can be used for application development, implementation of test- systems and for the cost-effective production of prototypes and small series. Using the system for training and educational purposes opens trend-setting perspectives with high efficiency at minimum costs per place of work.