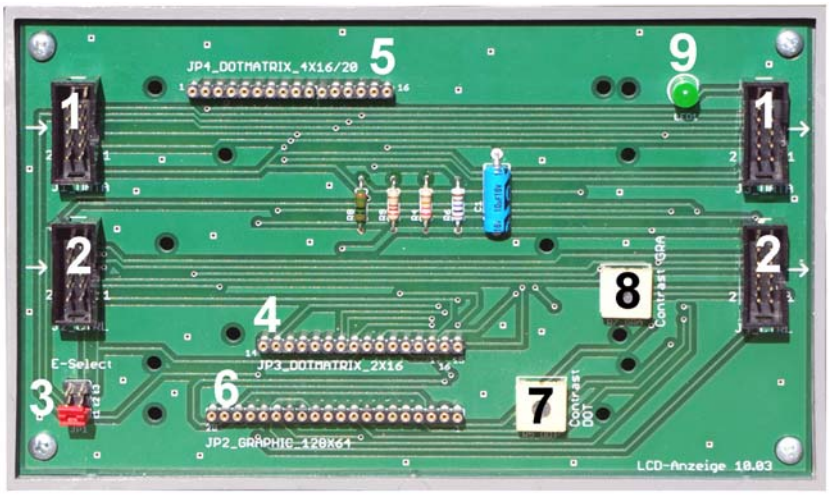
LCD Module 10a
Hardware Reference

Release 1.4a (October 11, 2017)

Purpose:
Platform to carry an LCD display module and to facilitate connection to other modules. Three types of LCD displays can be inserted: a dot-matrix module of 2 rows and 16 characters per row, a dot-matrix module of 4 rows and 20 characters per row, or a graphical module of 128 by 64 pixels. The LCD displays must have an industry-standard Motorola-type interface with control signals E (Enable (the strobe signal)), R/W# (Read/Write) and R/S (Register Select).

- 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.
- PCB can be stacked upon other modules having the same dimensions.
- Microcontroller interface: two 8-bit ports. One port data bus (bidirectional), one port control signals (outputs).
- Supply voltage: according to specifications of the LCD display. Most LCD displays require 5 V.



1	Data bus headers	6	Connector for graphical LCD 128 • 64
2	Control and strobe signal headers	7	Contrast adjustment for the dot-matrix LCDs
3	Enable-signal select jumper	8	Contrast adjustment for the graphical LCD
4	Connector for dot-matrix LCD 2 • 16	9	Power LED
5	Connector for dot-matrix LCD 4 • 20		

Fig. 1 The LCD module 10a.

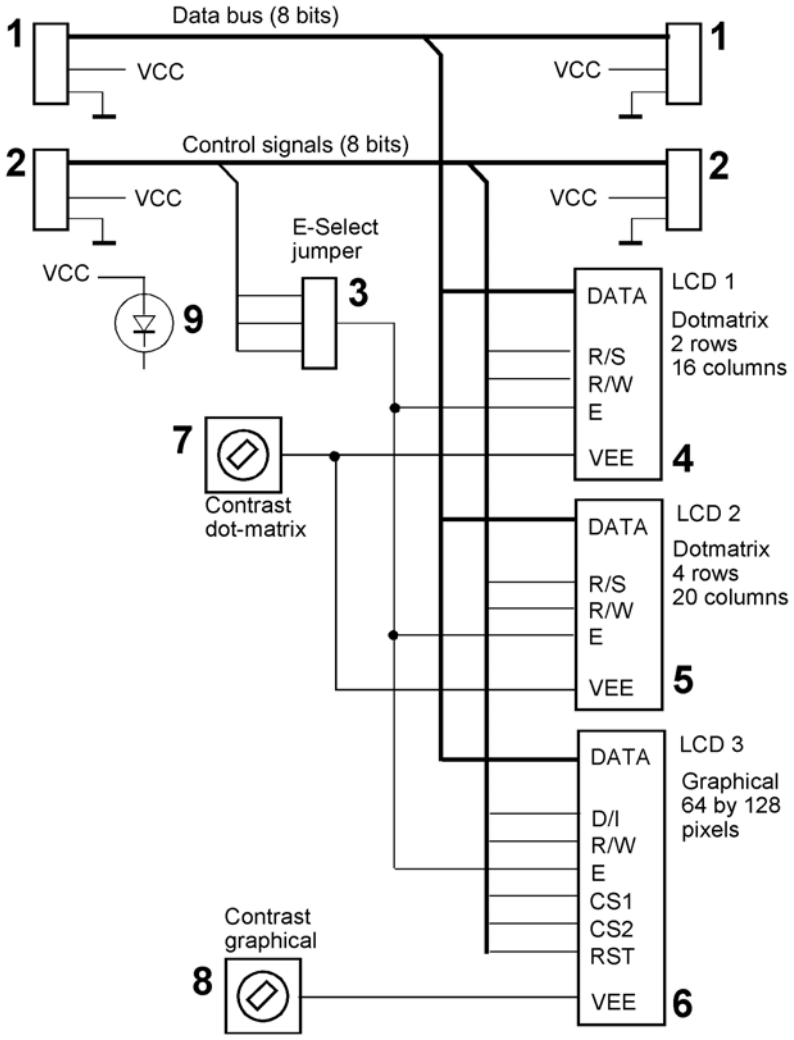


Fig. 2 LCD module 10a block diagram.

Principles of Operation

The interface comprises two 8-bit ports. One port is a bidirectional 8-bit bus, the other comprises eight control and strobe signals. Pin headers are mounted at both sides of the module, so that additional modules can be attached by daisy-chained connections. By appropriately setting a jumper, one of three enable signals can be selected for LCD control. So a maximum of three modules can be operated at one bus attached to two microcontroller ports.

Power Supply

Power must be supplied from outside. The board has no voltage regulator. The supply voltage depends on the LCD display inserted. Most LCD displays require VCC = 5 V. Some LCD displays may require somewhat close tolerances. Power is fed to the module via the I/O port connectors.

I/O port connectors (1), (2)
The I/O connectors are pin headers with 10 pins in two rows and a pin pitch of 2,54 mm (100 mil). Various types can be inserted (horizontal or vertical, on the component side or on the soldering side, shrouded or not and so on). The assignment of the I/O signals, GND and VCC corresponds to the industry standard of the Atmel starter kits and the like (Fig. 3). The GND and VCC contacts are used to supply the module. The upper port (1) is the data bus, the port (2) below comprises the control signals.

2	**4**	**6**	**8**	**10**
Bit 1	Bit 3	Bit 5	Bit 7	VCC
Bit 0	Bit 2	Bit 4	Bit 6	GND
1	**3**	**5**	**7**	**9**

Fig. 3 I/O port header pin assignment.

Enable-signal select jumper (3)
The E-input of an LCD display is the enable or strobe input, selecting the LCD display as the active slave on the data bus. Three of the eight control signals of the //O port (2) can be used as E-signals. One of these signals is to be selected by appropriately inserting a jumper. A maximum of three modules can be operated at one bus attached to two microcontroller ports. Each module must have its jumper inserted in a different position.
The Keypad / Input Module 10b has the same selection provisions. A keypad / input module can be the last module of a daisy-chain.

Caution:
The LCD module requires the E-signal active Low, the keypad / input module active High.

LCD displays (4), (5), (6)
The module is designed for insertion of the most widespread industry-standard module types (Fig.s 3, 4, 5). The LCD modules can be mounted with spacers.

Contrast Adjustment (7), (8)
There are separate trimpots for dot-matrix and graphics LCDs. When a particular LCD display is inserted, only the corresponding trimpot is accessible.

Power LED (9)
One of the most basic troubleshooting aids is an indication, whether a device is powered or not.

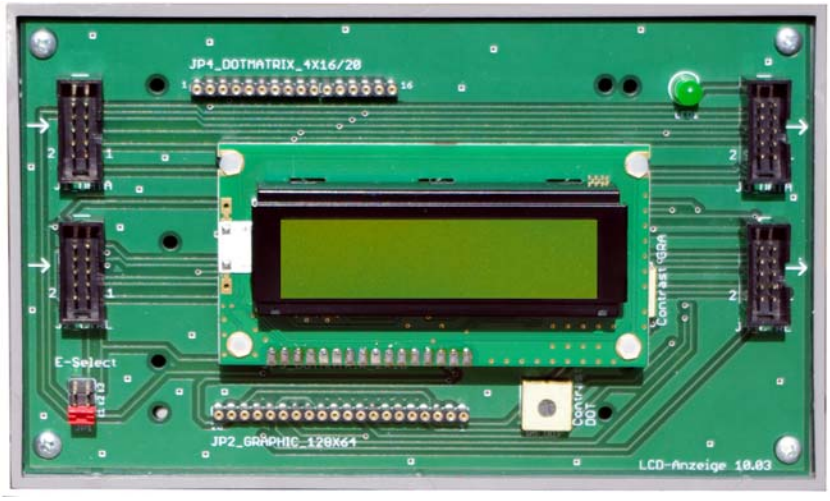


Fig. 4 Dot-matrix display; two rows of 16 characters. 16-pin connector. Footprint approx. 44 • 84 mm. Example: EA P152-NLED with controller HD44780.

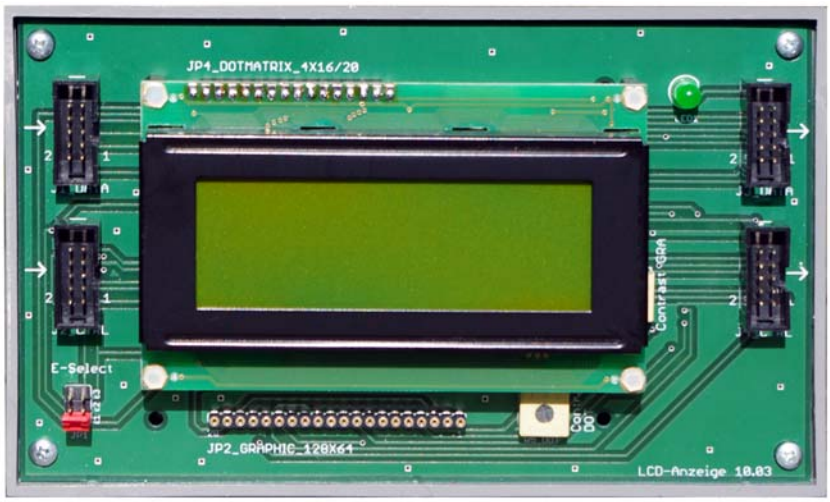


Fig. 5 Dot-matrix display; four rows of 20 characters. 20-pin connector. Footprint approx. 60 • 98 mm. Example EA P204-NLED with controller HD44780.

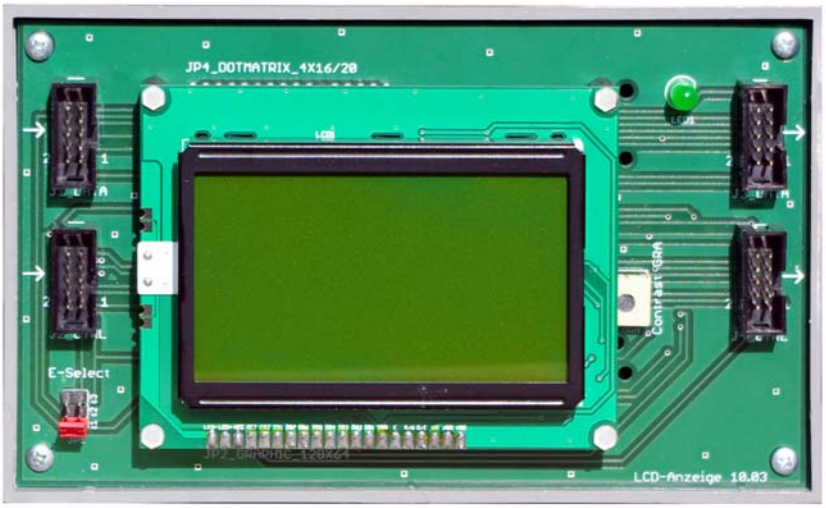


Fig. 6 Graphical display; 128 • 64 Pixel. 20-pin connector. Footprint approx. 70 • 93 mm. Example: EA E128-6N2LW with controller HD 61202.

Footprints of typical LCD Displays

The following drawings have been taken from appropriate data sheets. All measures are in mm.

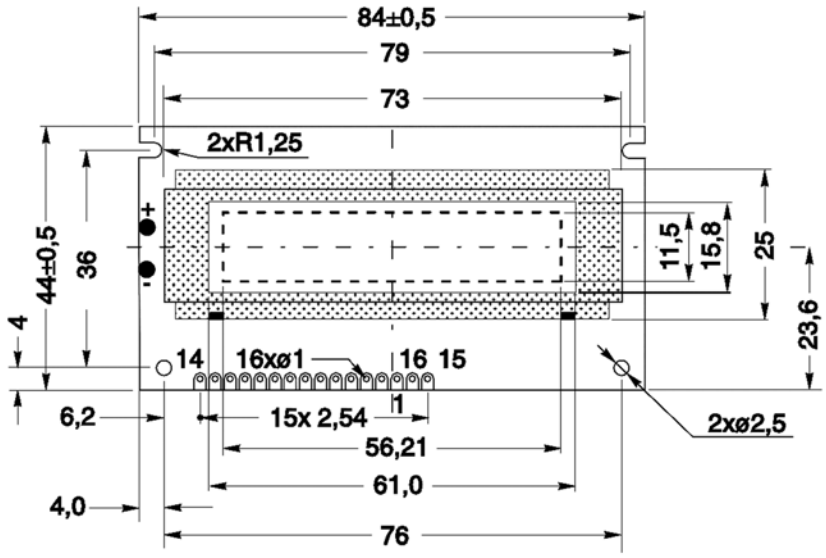


Fig. 7 Dot-matrix 2 • 16.

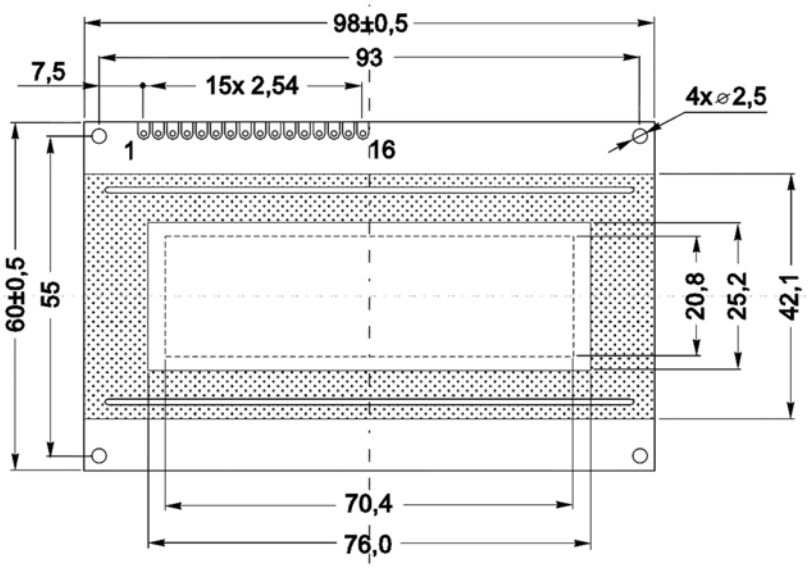


Fig. 8 Dot-matrix 4 • 20.

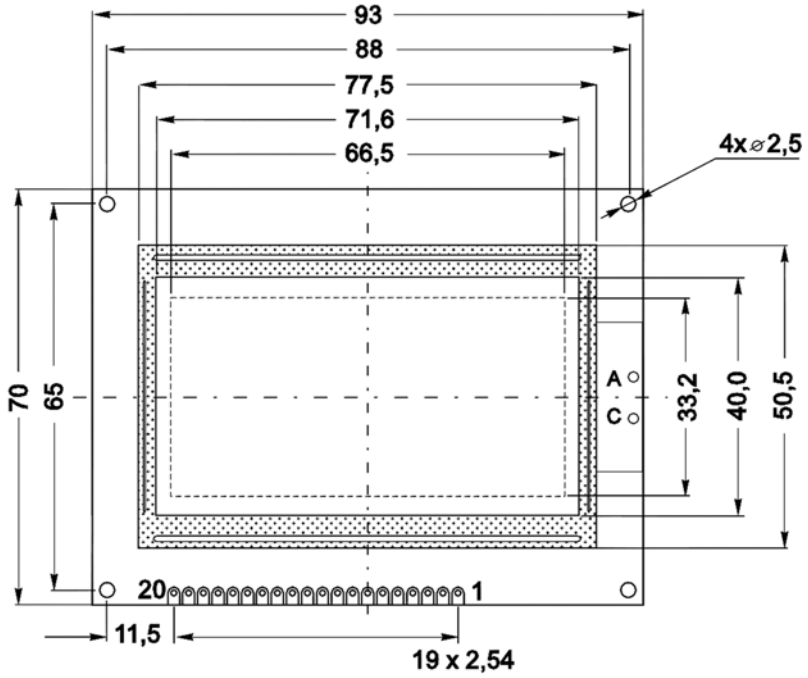


Fig. 9 Graphical 128 • 64.

Dot-matrix 2 rows (4):

14	13	12	11	10	9	8	7	6	5	4	3	2	1	16	15
D7	D6	D5	D4	D3	D2	D1	D0	E	R/W#	RS	VEE	VDD	GND	LED+	LED–

Dot-matrix 4 rows (5):

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
GND	VDD	VEE	RS	R/W#	E	D0	D1	D2	D3	D4	D5	D6	D7	LED+	LED–

Graphical (6):

20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
LED–	LED+	VOUT	RST#	CS2	CS1	D7	D6	D5	D4	D3	D2	D1	D0	E	R/W#	D/I#	VEE	VDD	GND

GND = VSS: 0 V (Ground).
VDD: + 5 V ((= VCC).
VEE: Contrast voltage input.
VOUT: Contrast voltage output.

Fig. 10 The LCD connectors.

The Programming Interface

7	6	5	4	3	2	1	0
D7	D6	D5	D4	D3	D2	D1	D0
Input and output (bidirectional)							

Fig. 11 The data bus.

7	6	5	4	3	2	1	0
E3	E2	RST#*	CS2*	CS1*	E1	R/W#	R/S; D/I#*
Output							

*: Graphical display.

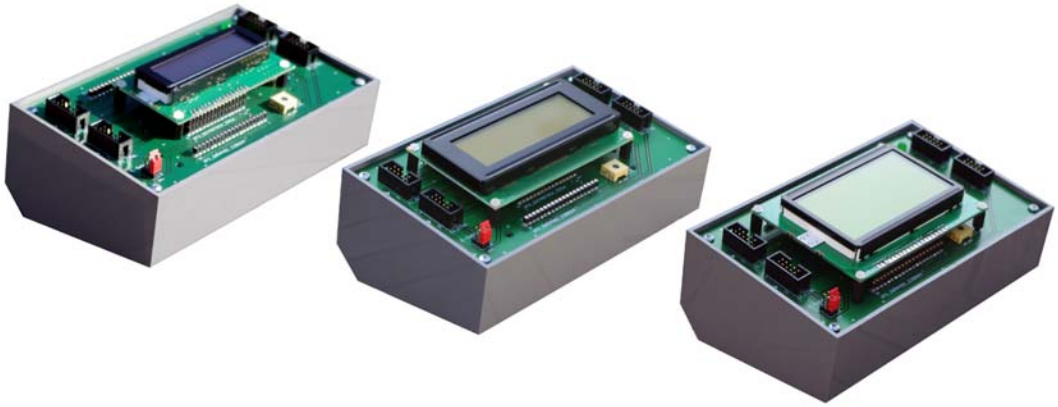
Fig. 12 The control and strobe signals.

Notes:

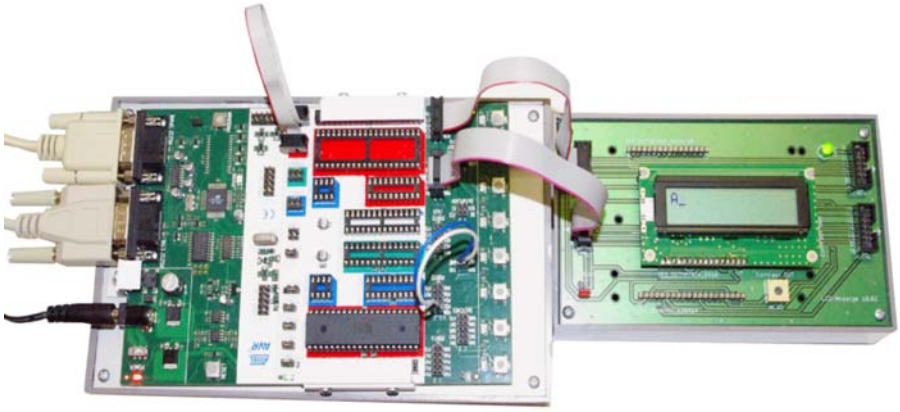
1. To each module, a particular enable-signal (E) must be assigned. Pay attention to the level at which the signal is active. The E-signal of a typical LCD display is active high. To hold the display in the idle state, E = 0 shall be programmed. A counterexample is the keypad/input module 10b. Its E-input is active low. Hence the idle state requires E = 1 to be programmed.
2. The data bus should not float too long. An inactive bus should be programmed for output (parking the bus) or programmed for input with pull-up resistors active.
3. Typical dot-matrix displays have pull-up resistors built in, wherever graphical displays have none.
4. Th data bus should be parked at High level (FFH bit pattern). So no current will be drawn over the display's pull-up resistors.
5. A preferred configuration: an LCD display configured to E1, eventually a second display to E2, and the keypad/input module to E3.

LCD Module 10a in Action

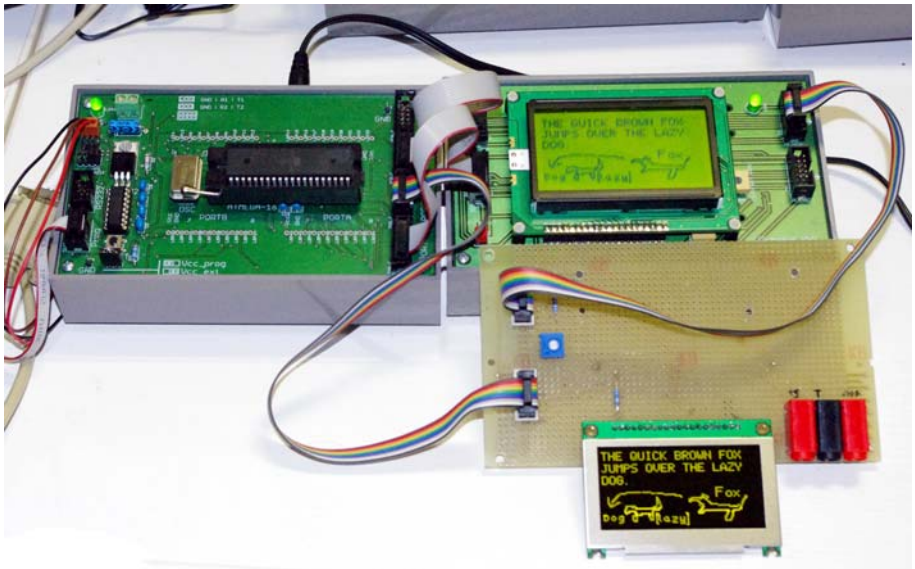
– A Photo Gallery –



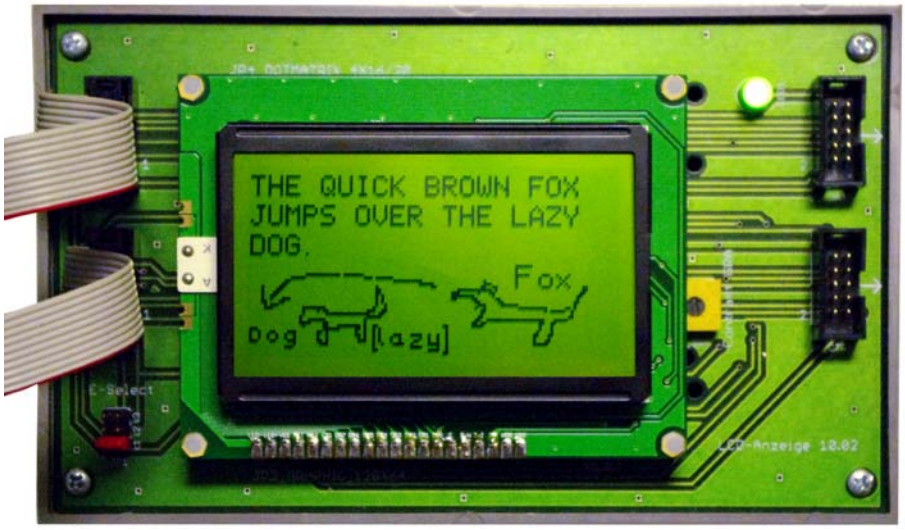
LCD module attached to an Atmel STK 500 starter kit.



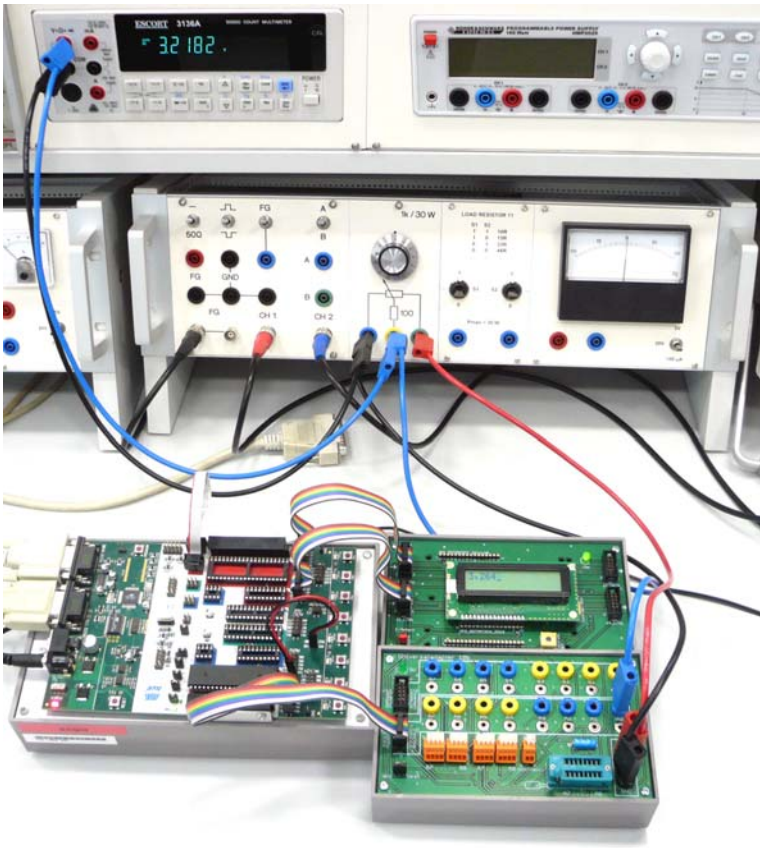
A provisional test setup to compare LCD with OLED displays.



A graphical display example.

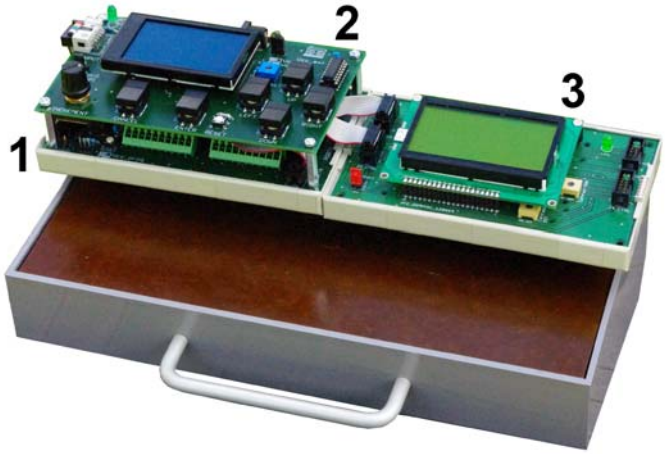


A student's exercise. A digital voltmeter is to be implemented. The general-purpose adapter in front of the LCD module delivers the analog voltage to the microcontroller's analog-to-digital converter.



Mounting the LCD module on a DIN rail.

An educational PLC (Programmable Logic Controller) has been assembled from three modules; a general-purpose microcontroller module (1), a human interface module (2), and an LCD module (3).



This PLC comprises two LCD modules, one with a dot-matrix and the other with a graphical LCD display. On the test rig shown, only the power stages and relays are lacking.