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# T-Bird – Expansion Board

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The T-Bird development board has an expansion board with many opportunities. The board has numerous visualisation and output devices.

## Visualisation devices

### LCD display, 4x16 character, HD44780 compatible

The LCD display is in 4bit data mode, therefore it has 3 control and 4 data lines. To display a character two write cycles have to be made.

### Seven segment display

The seven segment displays are multiplexed and they have a driver circuit. The driver circuit's input is BCD, there are only 4 data lines. The multiplexer's input is also BCD. We can choose with the multiplexer which display will be addressed. The smallest address is the rightmost display with zero, and the address increases to the left, up to three. The fourth address will turn on the two LEDs between the seven segment displays. With this topology a clock is easy to realise.

### RGB LED

On the board there is a tricolor LED. We can drive the three colors separately. For example with PWM signals 256 different colors are easy to achieve (4bit PWM resolution), or even 16 million (8bit PWM resolution).

## Output devices

### 3x4-es keyboard matrix

Giving an active signal to the rows (one at a time), and reading the columns, its easy to define wich button is pushed.

### LM35 temperature sensor

The temperature sensors output is connected to the microcontrollers analog input. The controllers internal A/D is used to get the sensors value. After the conversion is complete and multiplied with a scale coefficient the temperature is obtained.

## Pinout of the connectors

The board is fully compatible with the T-Birds pinout.

Connector	[Pin number]	I/O	Function
GPIO-A	[1]	Output	7seg. driver BCD „A”
	[2]	Output	7seg. driver BCD „B”
	[3]	Output	7seg. driver BCD „C”
	[4]	Output	7seg. driver BCD „D”
	[5]	Output	7seg. demux „A”
	[6]	Output	7seg. demux „B”
	[7]	Output	7seg. demux „C”
	[8]	Output	7seg. demux enable
GPIO-B	[1]	Input	Keyboard matrix left column
	[2]	Input	Keyboard matrix middle column
	[3]	Input	Keyboard matrix right column
	[4]	Output	Keyboard matrix first row
	[5]	Output	Keyboard matrix second row
	[6]	Output	Keyboard matrix third row
	[7]	Output	Keyboard matrix fourth row
	[8]	Output	RGB LED „Red”
Timer/Analog	[1]	Input	Temperature sensor
	[2]	Output	LCD RS
	[3]	Output	LCD R/W
	[4]	Output	LCD Enable
	[5]	I/O	LCD data[4]
	[6]	I/O	LCD data[5]
	[7]	I/O	LCD data[6]
	[8]	I/O	LCD data[7]
	[9]	Output	RGB LED „Blue”
	[10]	Output	RGB LED „Green”

## Linkek:

### LCD display – HD44780

[http://en.wikipedia.org/wiki/HD44780\\_Character\\_LCD](http://en.wikipedia.org/wiki/HD44780_Character_LCD)

<http://lcd-linux.sourceforge.net/pdffdocs/hd44780.pdf>

**Demultiplexer – 74HCT238**

<http://ics.nxp.com/products/hc/datasheet/74hc238.74hct238.pdf>

**7 seg. driver – HEF4511**

[http://www.nxp.com/documents/data\\_sheet/HEF4511B.pdf](http://www.nxp.com/documents/data_sheet/HEF4511B.pdf)

**Temperature sensor – LM35**

<http://www.national.com/ds/LM/LM35.pdf>