

Dwarf Boards

DN001 : introduction, overview and reference

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version 1.6

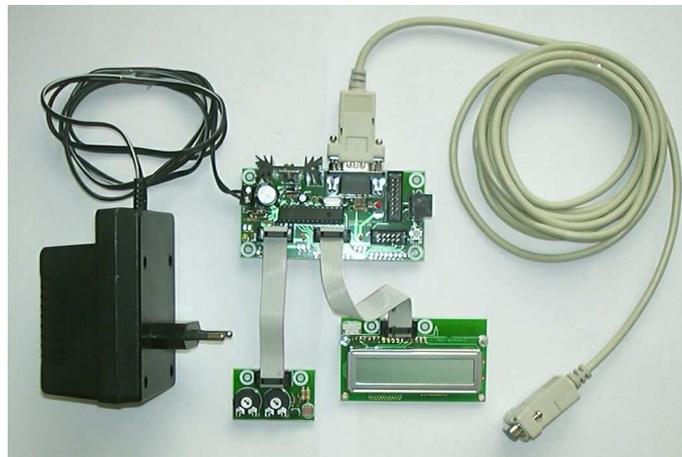
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Introduction

The Dwarf Boards product family comprises a set of printed circuit boards that can be used to create microcontroller-based circuits for education, experimenting, rapid prototyping and production of small series.

A typical Dwarf Board system consist of a PICmicro controller board and one or more peripheral boards. The flexibility of the Dwarf Board family lies in the Dwarf Bus connector used on all Dwarf Bords. This makes it possible to combine Dwarf Boards to fit your particular purpose.

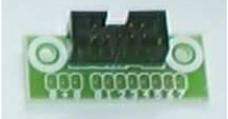
The picture below shows an example of a Dwarf Board system. The purpose of this system is to shows the ambient temperature on an LCD display. The system consists of a controller board with build-in power supply and bootloader hardware, an LCD peripheral board with LCD, and an analog peripheral board with an LM35 temperature sensor. Ribbon cables connect the boards. A wall wart powers the system. A serial cable connects to a PC for in-circuit programming.



a complete Dwarf Board circuit

The basic Dwarf Bus connector defines 8 data pins, a ground pin and a +5 Volt power pin. More specialised definitions assign specific functions to data pins, for instance for SPI, I2C, or UART (asynchronous serial). The Dwarf Board controller boards provide one or more Dwarf Bus connectors, the peripheral boards use (in most cases one) of these connectors.

Dwarf Board controller boards range from very simple, containing little more than a microcontroller and some Dwarf Board connectors, to more complex, containing for instance a power supply, a programming interface, or an LCD interface.

nr	picture	as ¹	features ²	description
DB012			4 pushbutton switches 4 DIP switches mounting holes at 2.95 mm	peripheral board for four small PCB-mounted pushbutton switches and four switch DIP switch block
DB013			one 7-segment LED display mounting holes at 2.95 mm	peripheral board for one seven segment LED display
DB014			8 + 3 pads or wire cups mounting holes at 2.95 mm	peripheral board for 8 (data) + 3 (ground, power, ground) solder pads or wire cups
DB016			28 pin PIC Wisp628 pinheader ICD2 jack ZPL DB9 connector 7805 with cooling LED on RA0 2 full DB connectors 1 partial DB connector	controller board for an 28-pin PIC the 7805 can be fitted with a 14 or 11 C/W cooling and is protected by a polyfuse intended as controller board for education and experimenting requires no programmer when used with an 18F PIC and the ZPL bootloader
DB017			LCD adapter	peripheral interface board for a 14 pin or 16 pin LCD 4-bit mode only backlight series resistor can be fitted LCD not included
DB021			dual motor driver	peripheral board for driving two motors. uses an L298 motor driver chip.
DB022			4 relais	peripheral board for 4 relais.

¹ available as:

- p bare PCB
- k kit
- b build and tested
- x not separately available

² features:

- ICD2 jack RJ45 jack for connecting a Microchip ICD1 or ICD2 programmer / debugger
- Wisp628 pinheader 2x8 pin header (pin 16 removed as key) for connection to a VOTI Wisp628 programmer
- ZPL DB9 connector DB9F connector for connecting a PC for use of the ZPL bootloader (can be used for 18F PICmicro's only)

mounting holes at 2.95 mm	standard mounting holes for a peripheral board on both sides of the Dwarf Bus connector, 2.95 mm apart, for M3 screws
DB connector	10-pin Dwarf Bus connector (ground, +5Volt, 8 x data)
small board	small board which can be trimmed to fit in the space of a Dwarf Bus connector (for direct mounting without a ribbon cable)

Development tools

To use a microcontroller-based system like Dwarf Boards two development tools are needed: an assembler or compiler to create the program, and a programmer to load this program into the microcontroller.

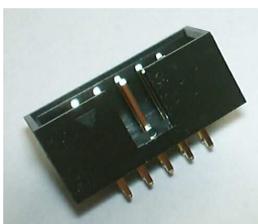
Dwarf boards can be used with any assembler or compiler suitable for the particular microcontroller that is used. Microchip, the manufacturer of the PICmicro controllers, provides the free MPLAB assembler development environment, which can be downloaded from <http://www.microchip.com>. The web page at <http://www.voti.nl/swp> provides (beside a general introduction) a list of some assemblers, compilers and interpreters available for PICmicro controllers. Libraries and example code for Dwarf Boards are available for the Jal compiler (which available under GPL from <http://sourceforge.net/projects/jal>).

When ex-circuit programming is used Dwarf Boards can be used with any programmer suitable for the microcontroller that is used. For the modern flash-based microcontrollers in-circuit programming is highly recommended. Most Dwarf Board controller boards provide one or more connectors for in-circuit programming, refer to the table of products for details. As a last resort for a board that provides no in-circuit programming connector a DIP clip can be used to connect directly to a DIP case controller.

Some Dwarf Board controller boards have on-board programming support. The DB016 for instance contains ZPL hardware. When used with a PICmicro equipped with the ZPL bootloader (18F PICs only) it can be connected directly to the serial port of a PC.

Connectors

The central concept of the Dwarf Boards is the Dwarf Bus connector. Physically it is a 10-pin low profile shrouded male header, as show on the picture below. On on a controller board the notch is oriented towards the board edge, on a peripheral board it is oriented away from the board edge (except when the connector is intended to connect to another peripheral board).



10 pin male shrouded header

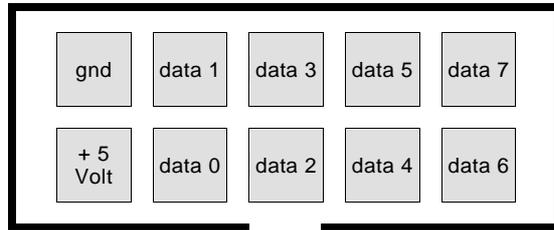


header on a PCB



crimp-on ribbon cable connector

The 10 pins of a Dwarf Bus connector are used to pass + 5 Volt power, ground, and 8 data lines. The pin assignment is shown in the table below. In most cases the + 5 Volt power will be provided by the controller board to the peripheral boards. An exception can for instance be an USB peripheral board that feeds USB power to a controller board.

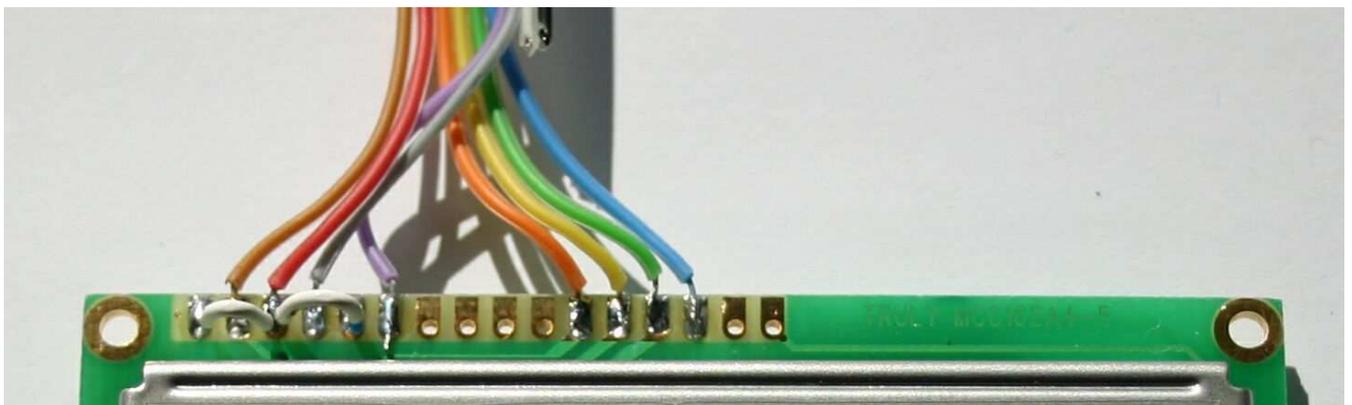


Dwarf Bus connector pin assignment, top view

In most cases connections between Dwarf Boards are made using ribbon cable with crimped connectors matching the Dwarf Bus connectors on the boards. When a standard colored ribbon cable is used (as shown on the picture, pin 1 connected to the brown wire) the table below shows the relation between the colors and the Dwarf Bus lines.

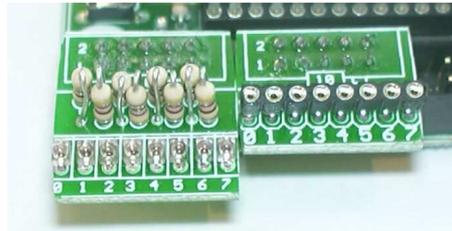
The table and picture also show how a ribbon cable can be connected to an HD44780 compatible LCD. The remaining LCD pins should be left unconnected. Note that this connection results in a contrast voltage of 0 Volt, which is OK for most displays but might not result in an optimal contrast for the particular viewing angle that you use. The DB015 documentation shows how a 10kΩ trim potentiometer can be used to get a contrast voltage that is adjustable from 0 .. +5 Volt.

wire color	Dwarf Bus function	LCD connection	
brown	+ 5 Volt	2	V+
red	ground	1 3 5	ground contrast R/W
orange	data 0	11	D4
yellow	data 1	12	D5
green	data 2	13	D6
blue	data 3	14	D7
purple	data 4	6	E
grey	data 5	4	RS
white	data 6	nc	
black	data 7	nc	

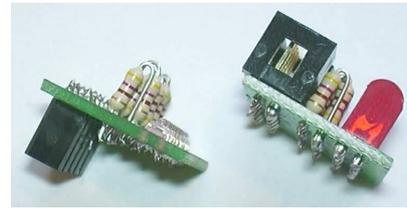


Some smaller boards are designed to fit within the width of a Dwarf Board Header, so they can be fitted directly on a header, as shown on the table below. This requires that a female header is fitted on the solder (back) side of the peripheral board, instead of or in addition to the male header at the components side. On a

controller board like the DB016 that has some distance between the Dwarf Board headers some wider boards can also be fitted this way.



small boards fitted directly on a Dwarf Bus connector



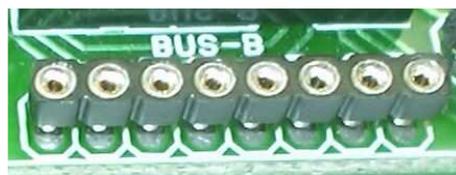
solder (back) side connector (left)
normal top side connector (right)

When a Dwarf Bus is used to carry asynchronous serial data (for instance from the microcontroller UART to a MAX232 line driver) the pin assignment shown below is used. In most cases a subset of these signals will be used.

data 0	transmit enable (for RS-485, active high)
data 1	not used
data 2	DSR
data 3	DTR
data 4	CTS
data 5	RTS
data 6	RxD (peripheral to controller)
data 7	TxD (controller to peripheral)

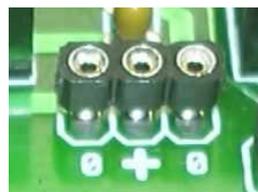
Dwarf Bus pin usage for asynchronous serial data

Within a Dwarf Board system data is in most cases distributed using Dwarf Bus connectors. In some cases a custom connection must be made, for instance to a solderless breadboard. In such cases wire cups provide a convenient way to make the connections. As shown on the pictures the data lines are numbered from left (0) to right (7).



data connection for wires: wire cups

Within a Dwarf Board system power is in most cases distributed using Dwarf Bus connectors. When + 5 Volt power and ground are available separately a three pin or three cup connector is used. The outer pins or cups connect to ground, the inner one connects to + 5 Volt. When in doubt, remember a coax cable: the outer layer is ground.



power connector: wire cups

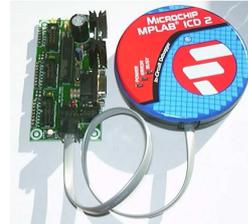


power connector: pin headers

The Microchip ICD1 and ICD2 in-circuit programmer /debuggers use an RJ45 modular connector to connect to the circuit with the target PICmicro. A number of Dwarf Boards provide a connector that is compatible with these products.



RJ45 connector

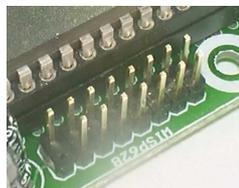


DB016 with a Microchip ICD2

pin	use
1	/MCLR
2	+ 5 Volt
3	Ground
4	RB7 (PGD)
5	RB6 (PGC)
6	not connected

RJ45 ICSP jack pinout

Most Dwarf Board controller boards provide a connector to connect to a Wisp628 programmer. This connector can either be a 2 x 8 pin shrouded header, or a (smaller) 2 x 8 pin header strip. Only the odd numbered pins are used. In both cases pin 16 is removed as key. The use of pins 11, 13 and 15 are optional, see the documentation of the specific board for details.



bare pin header



shrouded pin header



DB016 with a VOTI Wisp628

pin	use
1	Ground
3	+ 5 Volt
5	RB6 (PGC)
7	RB7 (PGD)
9	/MCLR
11	pulldown
13	UART TxD
15	UART RxD

2 x 8 pin Wisp628 connector pinout

Documentation

For each Dwarf Board a document is available that describes the board itself. This document explains the intended use, and contains the circuit diagram and assembly instructions. The table below summarises these documents.

document	title
DB016	DB016 - 28 pin PIC controller board with power and ZPL

A number of Dwarf Notes are available that document the Jal libraries that support the Dwarf Board products, and example projects using these libraries. These documents are summarised in the table below.

document	applicable boards	software	title
DN001	all		introduction, overview and reference
DN002	all controller boards	DB*.jal lcd_on_*.jal	Jal library
DN003	DB016	DN003.jal	Blink a LED in Jal on DB016
DN004	DB016 DB010 (3x)	DN004.jal	kitt-style display in Jal on 22 pins of a DB016
DN005	DB016 DB012 DB010	DN005.jal	copy BUS_B to BUS_C on DB016
DN006	DB016 DB011 DB010 (2x)	DN006.jal	simple analog input in Jal on DB016
DN007	DB016 DB013	DN007.jal	count on a seven segment display in Jal on DB016
DN008	DB016 DB015 (+ LCD)	DN008.jal	'hello world' on an LCD in Jal on DB016
DN009	DB016 DB011 DB015 (+ LCD)	DN009.jal	read 5 analog inputs, show on LCD, in Jal on DB016
DN010	DB001 DB010 (4x)	DN010.jal	kitt-style display in Jal on 32 pins of a DB001

Dwarf Board documentation can be downloaded from <http://www.voti.nl/dwarf>. All Dwarf Board documentation is in Adobe PDF format. Reader software can be downloaded from Adobe's website at <http://www.adobe.com>.

Change notes

the latest version of this document can be downloaded from <http://www.voti.nl/dwarf>

version	date	notes
1.6	2008-11-01	LCD connection colors corrected
1.5	2005-01-12	DB021 and DB022 added
1.4	2004-09-13	DB008 and DB015 removed, replaced by DB017
1.3	2004-03-30	colored ribbon cable and LCD connection added
1.2	2004-02-22	DN010 added
1.1	2004-02-08	boards added, boards renamed
1.0	2003-11-04	first version