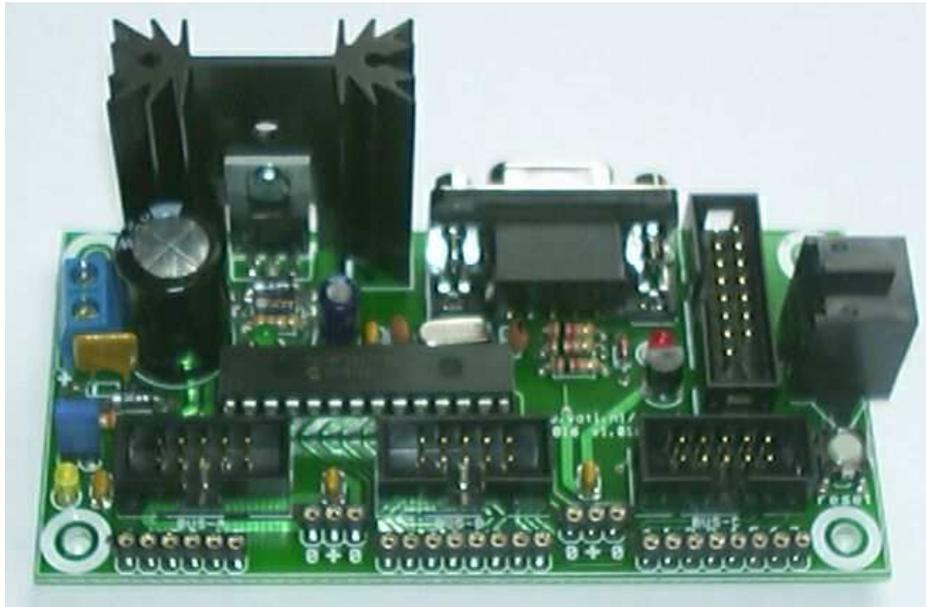


Dwarf Boards

DB016 : 28-pin controller board with power and ZPL

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Introduction

This document describes the Dwarf Board DB016. This board is a complete controller board, suited for educational use, experiments or prototyping.

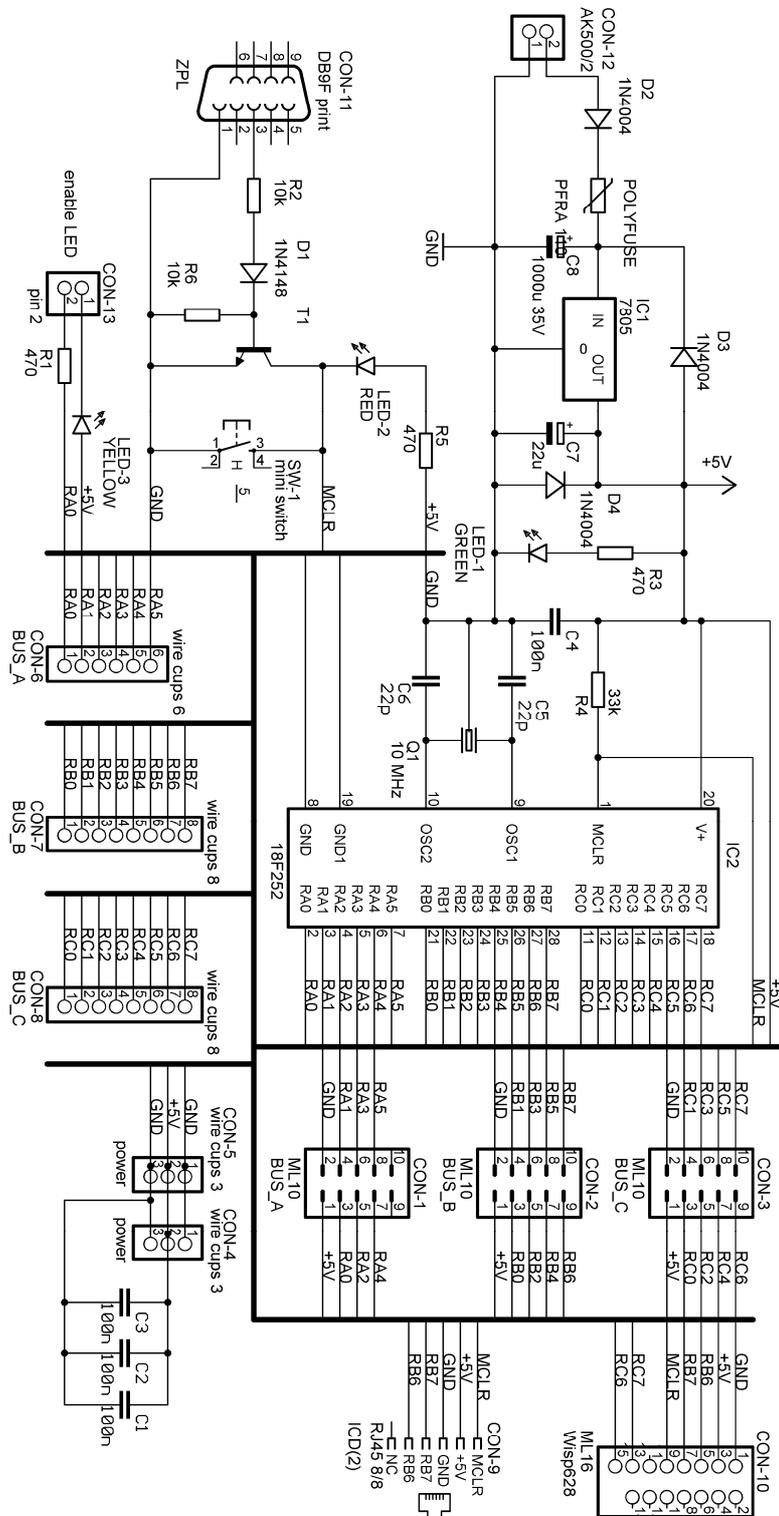
The board uses an 28-pin PIC microcontroller. It is intended for an 18F242 or 18F252, but it can be used with other 28 pin chips like the 16F876A.

The DB016 has an on-board 5 Volt regulator, which can - when fed with 9 .. 12 Volt and with sufficient cooling - provide 1 A. The 7805 regulator and a polyfuse provide protection against overload and short-circuit conditions.

The board contains Wisp628 and Microchip ICD connectors for In-Circuit Serial Programming, and the hardware for the use of the ZPL (Zero Pin Loader) bootloader. It also has a small pushbutton reset switch.

The board has LEDs for power and ZPL activity, and a LED which can be connected to bus_a_pin_0 by placing a jumper. It does (except for the nLED) not contain any peripherals. The I/O pins of the microcontroller are available on three Dwarf Bus (ML10) connectors for connecting Dwarf Board peripheral boards, and on wire cups for making connections to a solderless breadboard.

Circuit



The circuit consists of the following sections:

- a power supply (IC1, top left)
- ZPL hardware (T1, middle left)
- a test LED (LED-3, bottom left)
- the PICmicro chip (IC2, top middle)
- the Dwarf Bus connectors (CON-6 .. CON-8, and CON-1 .. CON-5)
- the ICSP connectors (CON-9 and CON-10, top right)

The power supply is a standard application of an 7805 (IC1). A wall-wart must be connected to the screw connector CON-12. A 12 Volt DC 1 Ampere wall-wart is recommended, which allows the total circuit (the DB016 and the connected peripherals) to use up to 1 Ampere. Note that with such a current IC1 and its cooling can get too hot to touch. Diode D2 protects against a reverse connection of the wall-wart. The polyfuse protects against a sustained current of more than 1 Ampere. Elco C8 provides extra filtering (a wall-wart often provides very poor filtering). R3 and LED-1 (green) provide a visible indication that power is present.

Diode D3 protects IC1 when 5 Volt is applied via one of the Dwarf Bus connectors. Diode D4 protects the circuit when the 5 Volt is applied in reverse.

When the board will be used (only) with 5 Volt supplied via a Dwarf Bus the following components can be omitted: CON-12, D2, Polyfuse, C8, IC1, D3.

A lower-current wall-wart can be used, provided that the total circuit does not draw more current than the wall-wart can supply. It is recommended that a suitable (lower rated) polyfuse is used. An AC wall-wart can be used, but the maximum current must be calculated by the user, based on the wall-wart voltage, the single-phase rectification, the filter capacitor C8 and the minimum input voltage required by IC1. A DC wall-wart with a lower voltage can be used, provided that the minimum input voltage of IC1 is maintained.

CON-11 is intended to be connected directly to a PC serial port (use a straight cable, not a null-modem cable). The components around T1 reset the PICmicro when the serial line is active. With suitable software (ZPL : Zero Pin Loader) on the PC and in the PICmicro this can be used to transfer an application to the PICmicro and run it. R5 and LED-2 (red) provide visible indication of ZPL activity. SW-1 can be used to reset the PICmicro manually.

When the ZPL functionality is not used the following components can be omitted: CON-11, R2, D1, R6, T1, LED-2, R5.

LED-3 (yellow) can be connected to bus_a_pin_0 (pin RA0 of the microcontroller) by placing a jumper on the pins of CON-13. This provides a minimum (blink-a-led) test function without using any peripheral hardware.

IC2 is the PICmicro. An 18F252 with a 10 MHz crystal is recommended (used with the x 4 PLL of an 18F a 10 MHz crystal makes the PIC run at its maximum of 40 MHz), but other 28 pin chips can be used, for instance a 16F676A. R4 is the /MCLR (reset) pull-up. C4 provides power decoupling.

The three Dwarf Busses are available on the ML10 connectors CON-1 .. CON3, and on the wire-cups CON4 .. CON-8. Note that BUS_A has only 6 data lines.

The connectors CON-10 (ML16) and CON-9 (RJ 6/6) can be used for in-circuit programming (ICSP) of the PICmicro using a Wisp628 programmer or Microchip programmer/debugger (for instance the ICD2).

Dwarf Bus pinout

The tables below show the correspondence between Dwarf Bus pins and PICmicro controller pins.

Dwarf Bus BUS_A	PICmicro port
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Dwarf Bus BUS_A	PICmicro port
pin_0	RA0
pin_1	RA1
pin_2	RA2
pin_3	RA3
pin_4	RA4
pin_5	RA5
pin_6	not connected
pin_7	not connected

Dwarf Bus BUS_B	PICmicro port
pin_0	RB0
pin_1	RB1
pin_2	RB2
pin_3	RB3
pin_4	RB4
pin_5	RB5
pin_6	RB6
pin_7	RB7

Dwarf Bus BUS_C	PICmicro port
pin_0	RC0
pin_1	RC1
pin_2	RC2
pin_3	RC3
pin_4	RC4
pin_5	RC5
pin_6	RC6
pin_7	RC7

Jal support

The table below shows the Jal board files for the DB016.

include file	for
DB016_18F252_10	DB016 with an 18F252 and a 10 MHz crystal, running at 10 MHz
DB016_18F252_20	DB016 with an 18F252 and a 20 MHz crystal, running at 20 MHz
DB016_18F252_PLL_40	DB016 with an 18F252 and a 10 MHz crystal, using the PLL to run at 40 MHz (this is the recommended configuration, and it is required when ZPL is used)

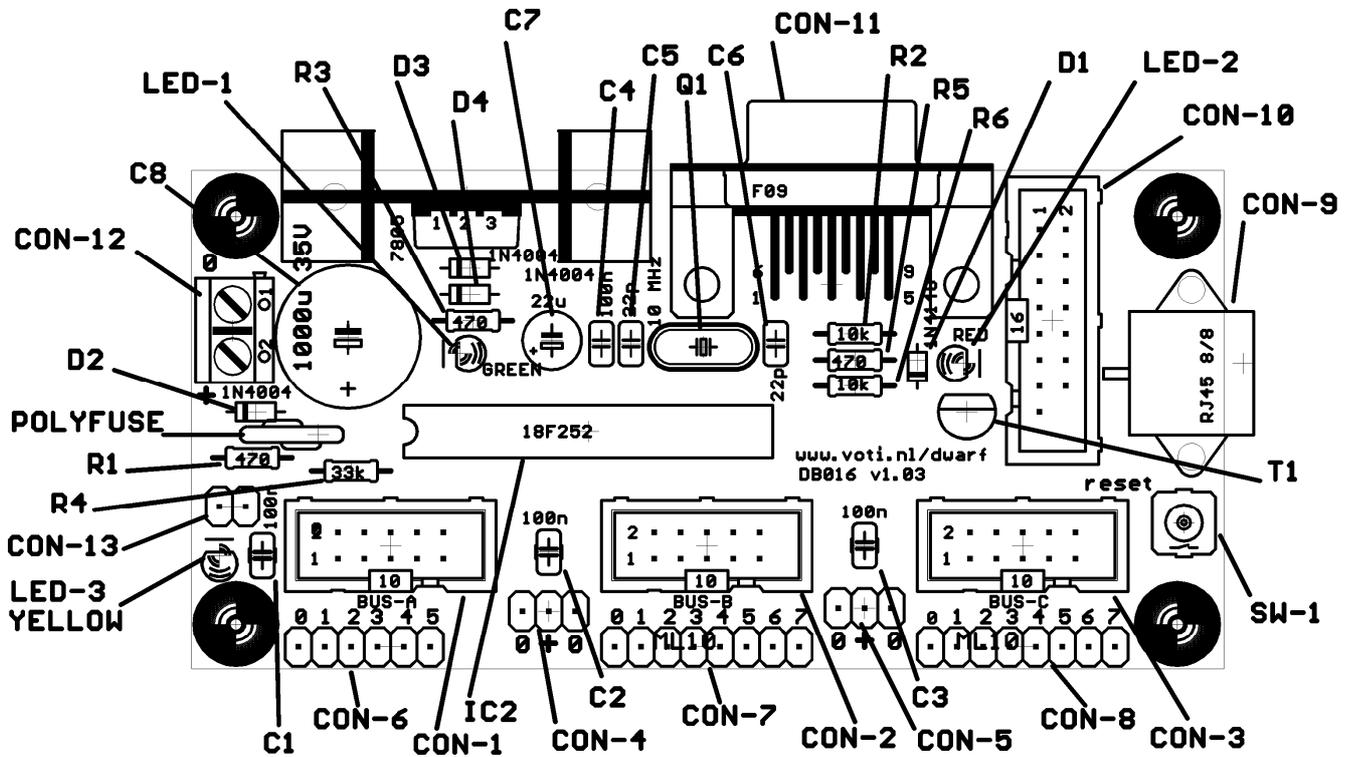
Other software

The ZPL firmware (the software for the PICmicro) can be found at <http://www.voti.nl/zpl>. Accompanying PC software can also be found on this page.

Microchip provides a C compiler for the 18F chips. This compiler is expensive, but a demo version of this C18 compiler can be downloaded from Microchips website. See links at the end of this document.

Component Placement

The figure below shows the placement of the components on the PCB. Note: the values shown for R2 and R6 in this picture are wrong, the correct values are 2k2 and 1k.



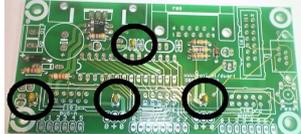
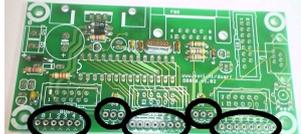
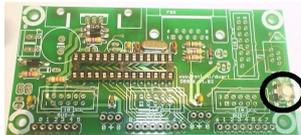
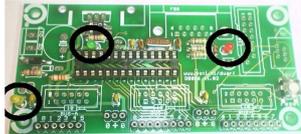
Assembly

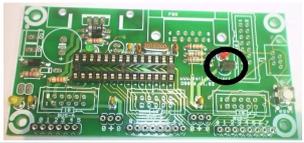
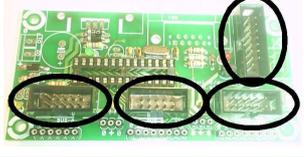
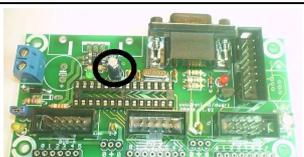
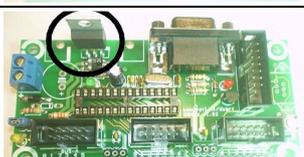
The kit contains the PCB and all components as shown in the circuit diagram, except (depending on the kit) the PICmicro controller.

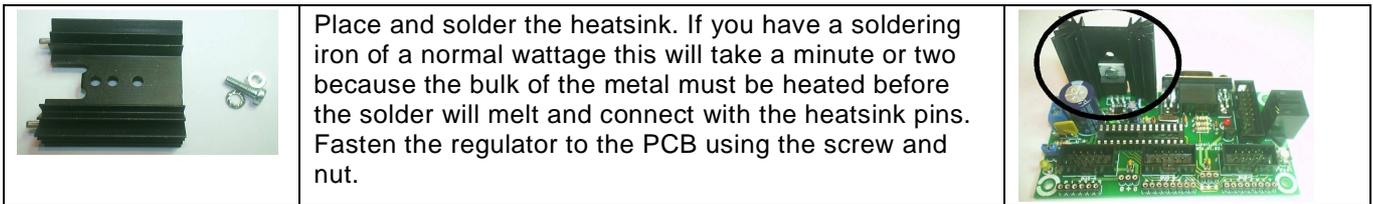
Assembling the kit is not difficult, no fine-pitched or SMD components are used. Just follow the instructions below carefully. Some soldering experience is recommended.

Orient the PCB as shown on the pictures and in the previous paragraph. The silkscreen (component side) text should be readable.

	<p>Place and solder the 1N4148 diode D1. The dark band must point down.</p>	
	<p>Place and solder the three 470 Ω resistors (yellow-purple-brown) R1, R3, R5.</p>	

	<p>Place and solder the 2.2 kΩ resistor R2 (red red red, nearer to the top of the board), and the 1 kΩ (brown-black-orange) resistors R6 (nearer to the centre of the board).</p> <p>note: the picture to the left shows two 10 kΩ resistors.</p>	
	<p>Place and solder the 33 kΩ resistor (orange-orange-orange) R4.</p>	
	<p>Place and solder the three 1N4004 diodes D2, D3, D4. The light band must point towards the left. Note that directly below the leftmost diode there might be a silkscreen marking for a diode (PCB versions 1.02 and below, white band points to the right) where in fact a polyfuse will be fitted.</p>	
	<p>Place and solder the four 100nF capacitors (marked 104) C1, C2, C3, C4.</p>	
	<p>Place and solder the two 22pF capacitors (marked 22) C5 and C6.</p>	
	<p>Place and solder the 10 MHz crystal X1. Note that the two plastic isolators must be put between the capacitor and the board, to prevent shorts between the component-side traces and the crystal case.</p>	
	<p>Place and solder the five wire cups (two 3-cups, one 5-cups, two 8-cups).</p>	
	<p>Place and solder the IC socket. The notch must be at the left side.</p>	
	<p>Place and solder the pushbutton switch. Some force will be needed to push its legs into the PCB holes.</p>	
	<p>Place and solder the three LEDs. LED-3 (yellow) is placed near the left edge, LED-1 (green) above the left side of the IC socket, LED-2 (red) on the right side of the board. The longer of the two leads of each LED must be inserted in the silkscreen LED marker (circle with a flattened side).</p>	

	<p>Place and solder the BC550 transistor T1. The flat side is oriented to the top of the PCB.</p>	
	<p>Place and solder the three 10-pin connectors CON-1, CON-2 and CON3, and the 16-pin connector CON-10. You will have to remove one pin from the 16-pin connector, take care to remove te correct one. You can easily pull the pin from the connector.</p>	
	<p>Place and solder the 2-pin header CON-13.</p>	
	<p>Place and solder the 2-screw connector CON-12.</p>	
	<p>Place and solder the DM9 connector CON-11.</p>	
	<p>Place and solder the 22 uF capacitor C7. The white band must be towards the top of the board.</p>	
	<p>Place and solder the 7805 current regulatir IC1. The leads must first be bent like show on the picture. Solder one pin first, check heck</p>	
	<p>Place and solder the 1000 uF capacitor C8. The white band must be towards the top of the board.</p>	
	<p>Place and solder the RJ 6/6 connector CON-9.</p>	



Links

- Microchip C18 compiler : <http://www.microchip.com/1010/pline/tools/picmicro/code/mplab18/index.htm>
- The PIClist is a mailing list for PIC users. Heavy traffic, but good information. <http://www.piclist.com>
- The Jallist is a mailing list for Jal users. <http://www.voti.nl/jal/index.html>

Change notes

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

version	date	notes
1.03	2008-11-05	RJ45 8/8 changed to RJ 6/6
1.02	2004-01-13	ZPL resistors changed
1.01	2003-12-16	texts corrected and extended assembly instructions added
1.0	2003-11-04	first version