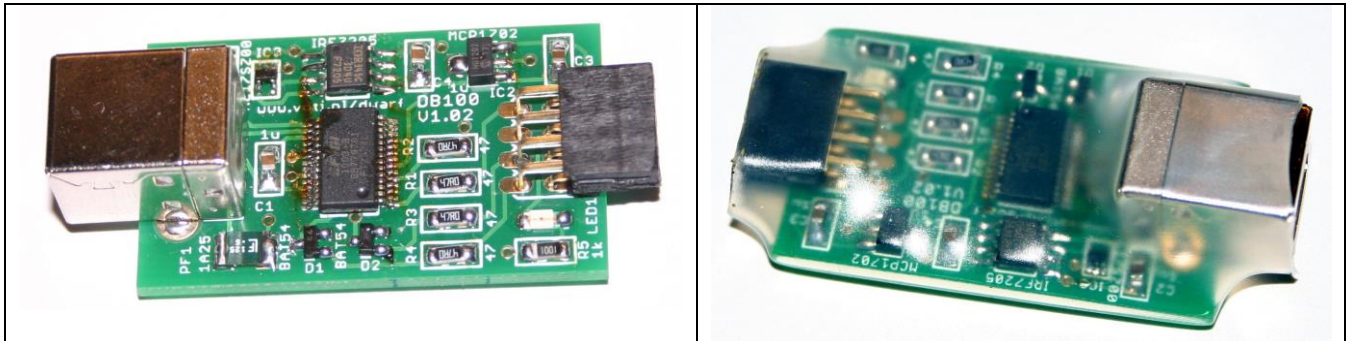


Dwarf Boards

DB100 : LPC USB bootloader

(c) Van Ooijen Technische Informatica

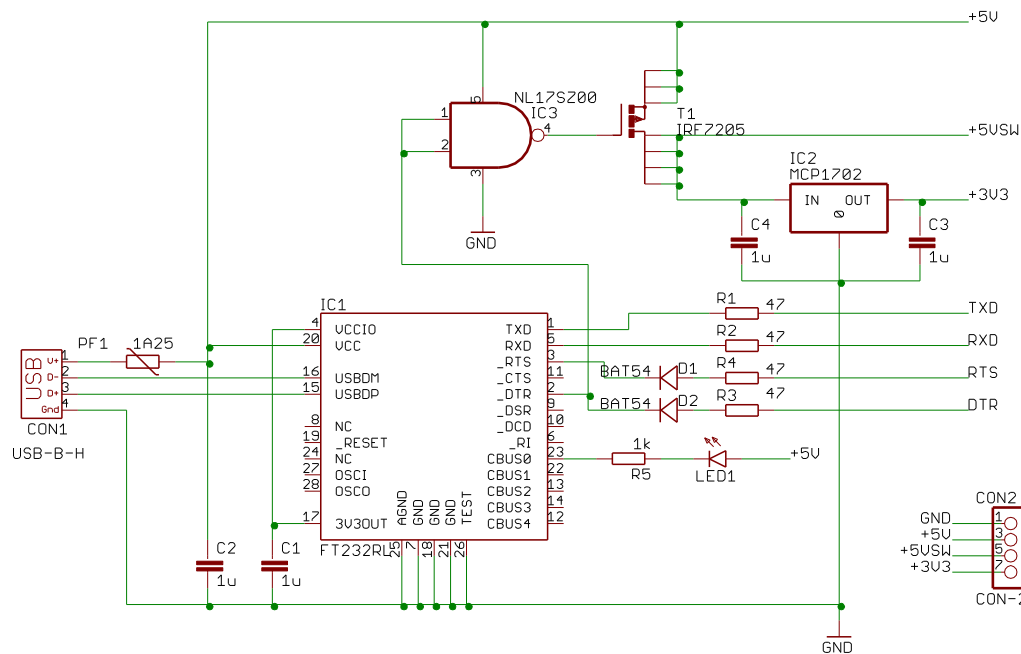


DB100 without and with crimp sleeve

Introduction

This document describes the Dwarf Board DB100. This small board is an USB-to-serial converter intended for downloading an application to an NXP LPC microcontroller, using an appropriate PC application like lpc21isp or Flash Magic. The bootloader connects to a PC using USB, and to the target microcontroller circuit using a 2x4 pin header connector. The bootloader provides the 5V from the USB to the target circuit, a 3V3 supply that is derived from the 5V, and it can power-cycle these supplies to still force a target chip that has no active reset pin into reset. The bootloader uses an FT232RL chip, for which PC drivers are available for most PC operating systems from <http://www.ftdichip.com>.

Circuit



The central part of the bootloader circuit is an FT232RL USB-to-serial bridge chip. The serial pins TxD and RxD are (via two 47 Ω resistors) fed to the target connector. The two handshake lines RTS and DTR likewise fed to the target connector, but with a Schottky diode in series so the corresponding target pin can only be pulled low. The DTR line is intended to pull the target chip into reset, while the RTS line pulls the BOOTMODE pin low to force the chip into boot mode when the reset is released. The CBUS0 pin is connected to a LED that will light up when the PC sends something.

The 3V3 output of the FT232 chip is fed to its VCCIO pin, hence the IO of the chip operates at this voltage.

The 5V provided by the USB is protected by a 1.25 A polyfuse (= slow but self-resetting fuse). The MCP1702 linear regulator lowers the voltage to 3.3V, which is the normal voltage for an LPC target chip to run on. The MCP1702 can supply up to 250mA, but it will get quite hot at that current. If the target circuit requires more current it can regulate the 5V down itself, up to the current the USB port can supply. Note that officially this maximum is only 100mA (without negotiation, which the download does not do). In practice most USB ports do not limit the current, and you can draw up to 500 or even 1000 mA without problems.

The IRFZ7205 series MOSFET and the NL17SZ00 single NAND gate (wired to function as an inverter) serve to temporarily remove the power (from the +5VSW and +3V3 lines) while the target is reset. Some target chips need a power cycle to be forced into reset and then into bootloader mode.

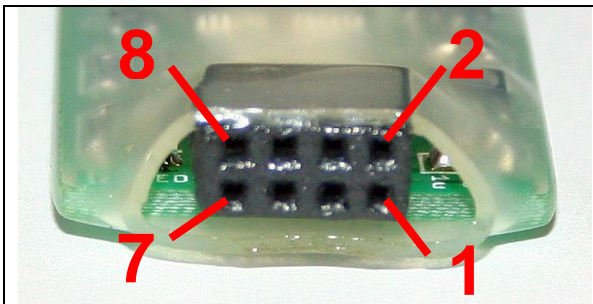
Both the unswitched and the switched 5V are available on the target connector, in case the target circuit needs 5V or needs more current than the MCP1702 can provide. When the target needs 3V3 but does not want it to be switched the +5V and +5VSW can be shorted by the target circuit to disable the power switching.

Target connector pinout

The target connector is a 2 x 4 pin 2.54mm spaced pin header socket. The target circuit must at the minimum connect the appropriate target pins to the Ground, RxD and TxD pins (target TxD to loader RxD!). This enables serial communication.

One step up in functionality is to connect the Reset and Bootmode pins to the appropriate target pins, this enables the PC to force the target to reset and into bootmode. Note that the bootloader will only pull these line low, it is up to the target circuit to provide pull-up resistors when needed (some target chips have these built in and enabled by default).

The final step is to power the target chip or even the full target circuit from the bootloader. This enables the bootloader to force a target chip into reset (and into bootmode), even when its reset pin has been reconfigured to function as a GPIO.



Pin	Function
1	Ground
2	TxD
3	+5V not switched
4	RxD
5	+5V switched
6	Reset (pulldown only)
7	+3V3 switched
8	Bootmode (pulldown only)

Note that the connector on the target circuit must be the mirror of the bootloader connector as shown above.

PC software

I know of two PC applications that can be used to download an application to an PLC microcontroller: Flash Magic and lpc21isp. Both support forcing the target into reset and download mode, downloading the application, and communicating with the application through a simple terminal emulator.

Flash Magic is a windows application available from <http://www.flashmagictool.com/>. A free version is offered, and paid versions that offer more functionality. It has a GUI (which will probably be the easiest way for a new user), but also a command line interface. I prefer the command line interface, because it allows me to automate the building, loading and running of an application. The documentation is not very clear on the correct command line, so I'll give you an example for downloading application.hex to an lpc1114/102, using COM4 at 38400 baud:

```
"C:/Program Files (x86)/Flash Magic/FM" 'COM(4,38400) DEVICE(LPC1114/102, 12000000, 0)
HARDWARE(BOOTEXEC, 50, 100) ERASE(DEVICE, PROTECTISP) HEXFILE(application.hex,
NOCHECKSUMS, NOFILL, PROTECTISP)'
```

Lpc21isp is an open-source command line application. The latest version hangs out at Yahoo Groups (<http://tech.groups.yahoo.com/group/lpc21isp/>). For windows I compiled it with DevCpp without having to make any change. The lpc21isp command line for downloading an application and starting a terminal emulator to communicate with it is:

```
lpc21isp -control -term application.hex COM4 38400 12000
```

I prefer lpc21isp over Flash Magic, but the current lpc21isp version (1.87) seems to have trouble downloading some applications that Flash Magic downloads correctly, so I am stuck with FM until this is resolved.

Change notes

The latest version of this document can be downloaded from <http://www.voti.nl/DB100>

Version	Date	Notes
1.0	2013-01-08	first version