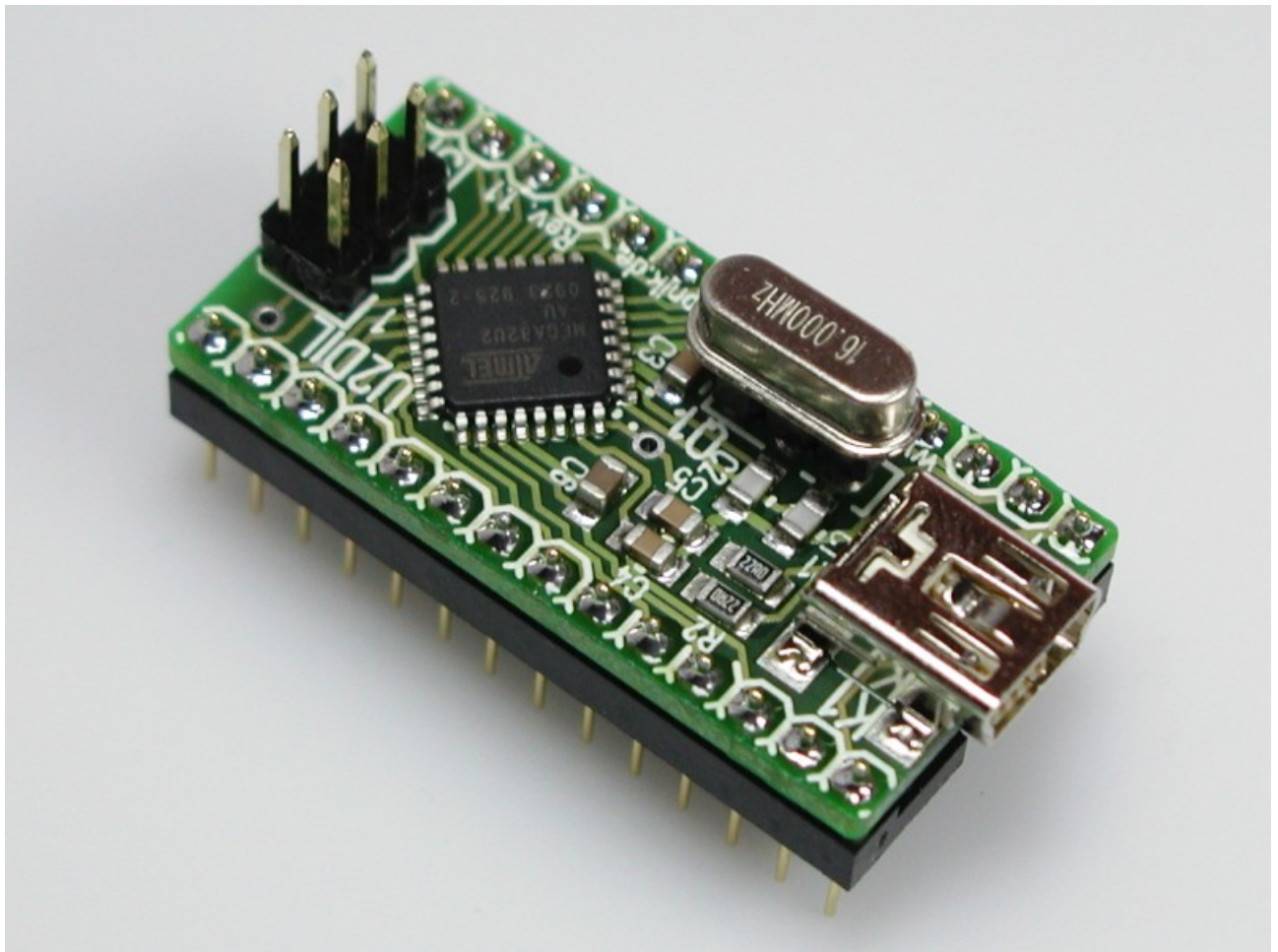# U2DIL

AVR USB Module

Rev. 1.1
Documentation Rev. 37

Reusch Elektronik

© 2010 Reusch Elektronik, Dipl.-Ing. (FH) Rainer Reusch

www.reusch-elektronik.de

http://products.reworld.eu/u2dil.htm

Contents

1. Introduction

U2DIL is a tiny interface module for an Atmel AVR micro controller with USB interface in TQFP32 casing. The module fits to an ordinary 28 pin dual-in-line socket. The U2DIL module is helpful in experiments, development and prototyping with USB-AVR micro controllers.

The module contains the crystal oscillator. A socket is used, so it is easy to replace the crystal or ceramic resonator to get the required frequency.

The USB interface (mini USB plug) is on board.

The module contains a 6 pin header for in-system-programming (Atmel 6 pin ISP standard). These pins are also available by the dual-inline connector pins.

The U2DIL module is easy to use, because it contains all necessary and time critical interfaces. On the other hand it gives full flexibility in power supplement and connectivity!

1.1 Assembly Variations

The module is available in two assembly versions:

- as "U2DIL-AT90USB162", assembled with AT90USB162 from Atmel
- as "U2DIL-ATMEGA32U2", assembled with ATMEGA32U2 from Atmel

The printed circuit board is also available "naked" (not assembled). It is suitable for the following Atmel microcontrollers with TQFP32 casing:

- AT90USB82
- AT90USB162
- ATMEGA8U2
- ATMEGA32U2

1.2 Oscillator

A 3 pin socket is used for the oscillator. This makes the module suitable for a

- crystal (HC49)
- 2 pin ceramic resonator
- 3 pin ceramic resonator

All devices in wired technology (no SMD). It might be necessary, to remove the two 22pF capacitors (C1 and C2), if a 3 pin ceramic resonator is used.

For correct USB function, the following frequencies are recommended:

- 8.000MHz
- 16.000MHz (delivery standard)

1.3 Introduction Example

The wiring example as shown, supplies the module by USB. Programming can be done via USB, bootloader and "Atmel Flip".
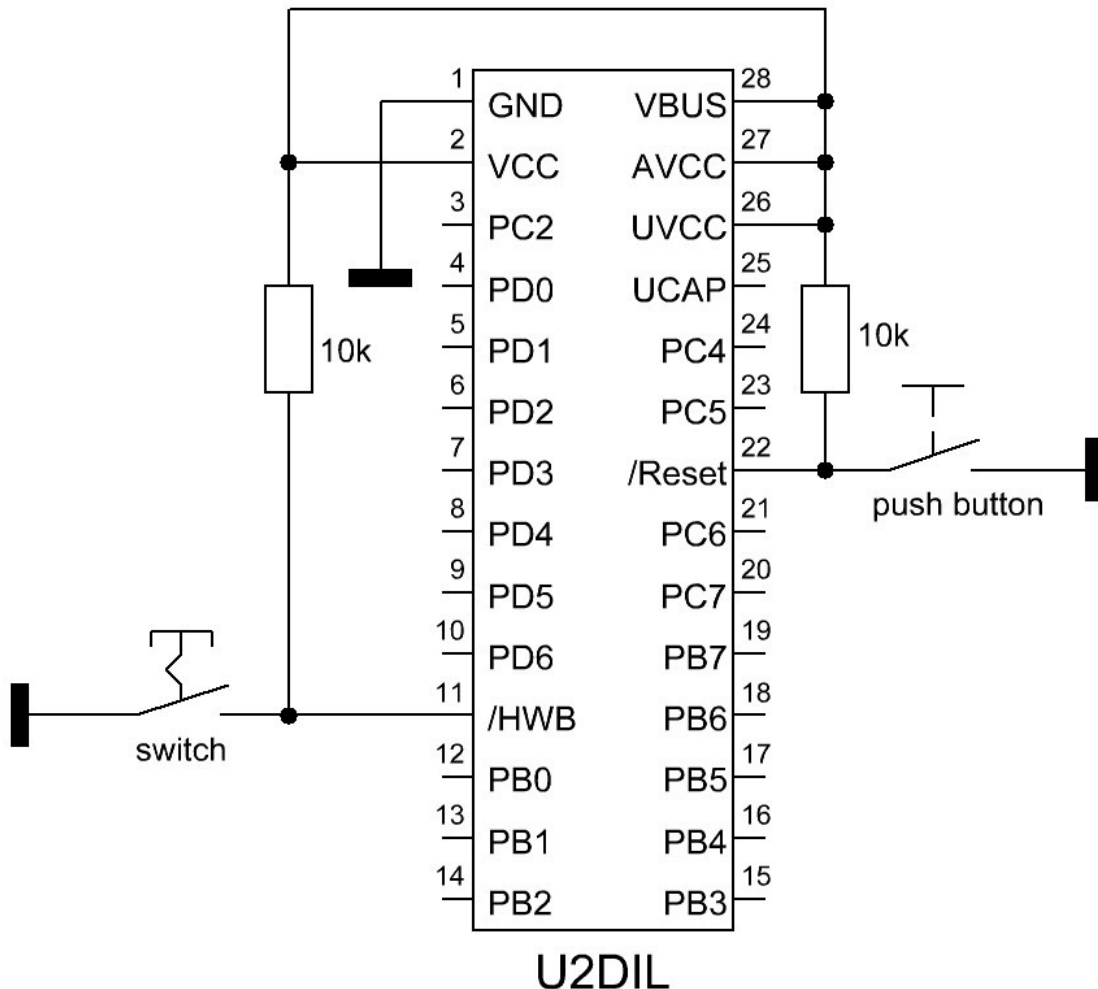
Without firmware, the module always will enter the bootloader. It will respond as "Atmel device" at the personal computer. At the first plugging, it is asked for a driver installation. You have to use the LibUSB-Win32 drivers, which are coming with the "Atmel Flip" installation package.

After the driver installation, the device can be accessed by "Atmel Flip" to program your firmware application. After programming, the device has to be unplugged from USB (turn off power supply) and the $\overline{\text{HWB}}$ switch has to be changed to "open" state.

When the device is plugged again, it will run with your programmed firmware.

To reenter the bootloader, close the $\overline{\text{HWB}}$ switch and push the $\overline{\text{Reset}}$ button for a moment.

Please note:

There are more options, to supply the device. The device also can be programmed via *ISP* interface and ISP programmer. For more information read the application note chapter, please.

2. Technical Information

2.1 Schematic
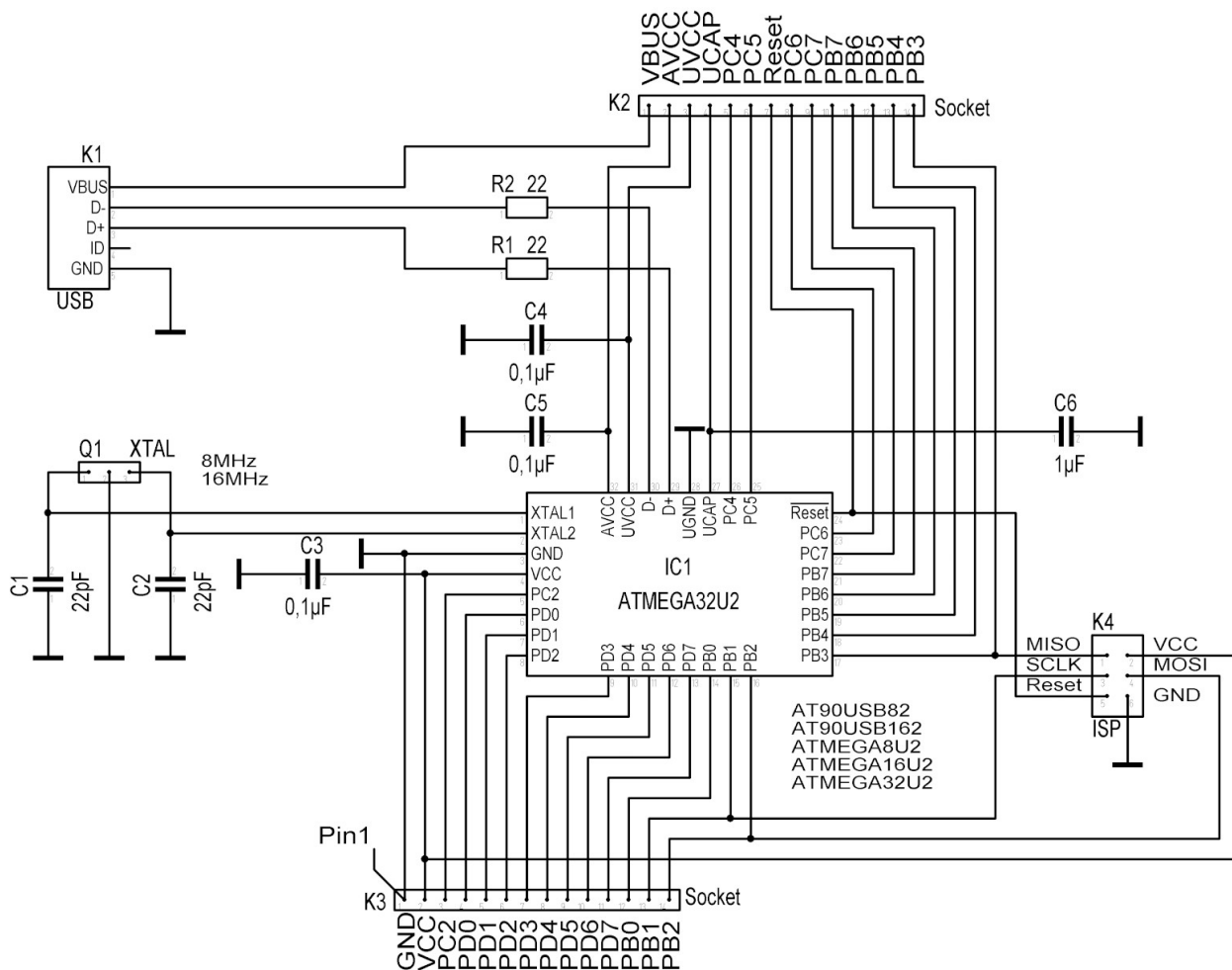
2.2 ISP Pin Assignment

The in-system programming adapter is a 6 pin header, which corresponds with the 6 pin Atmel ISP connector. Therefore the usual Atmel in-system programmers (such as "AVR ISP MKII") are suitable.

Pin	Function		Function	Pin
1	MISO		VCC	2
3	SCLK		MOSI	4
5	Reset		GND	6

2.3 Dual-Inline-Socket Pin Assignment

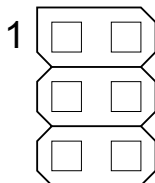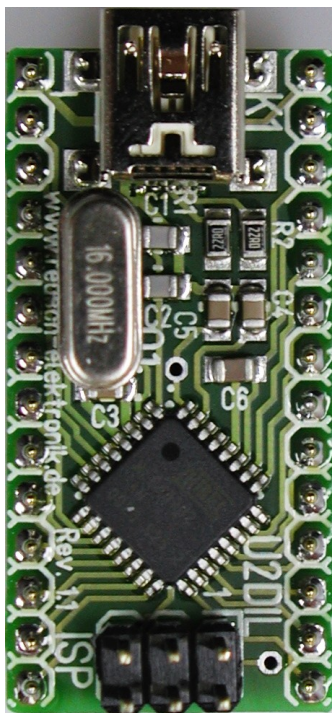The pin assignment of the dual-inline connector.

Pin	Function		Function	Pin
1	GND		VBUS	28
2	VCC		AVCC	27
3	PC2 (PCINT11, AIN2)		UVCC	26
4	PD0 (OC.0B, INT0)		UCAP	25
5	PD1 (AIN0, INT1)		PC4 (PCINT10)	24
6	PD2 (RXD1, AIN1, INT2)		PC5 (PCINT9, OC.1B)	23
7	PD3 (TXD1, INT3)		$\overline{\text{Reset}}$ (PC1, dW)	22
8	PD4 (INT5, AIN3)		PC6 (OC.1A, PCINT8)	21
9	PD5 (XCK, AIN4, PCINT12)		PC7 (INT4, ICP1, CLKO)	20
10	PD6 ($\overline{\text{RTS}}$, AIN5, INT6)		PB7 (PCINT7, OC.1A, OC.1C)	19
11	PD7 ($\overline{\text{CTS}}$, $\overline{\text{HWB}}$, AIN6, T0, INT7)		PB6 (PCINT6)	18
12	PB0 ($\overline{\text{SS}}$, PCINT0)		PB5 (PCINT5)	17
13	PB1 (SCLK, PCINT1)		PB4 (T1, PCINT4)	16
14	PB2 (PDI, MOSI, PCINT2)		PB3 (PDO, MISO, PCINT3)	15

The "alternative function" is related to ATMEGAxU2. For more information about the alternative pin usage, please refer to the Atmel data sheets.

2.4 Technical Data

Supply Voltage	3.0V to 5.5V
Supply Current	<50mA (depends on application)
Clock Frequency	8.000MHz or 16.000MHz (required for USB compatibility)
Operation Temperature	-25°C to 70°C
Storage Temperature	-25°C to 85°C

For further information related to the microcontroller, please refer to the Atmel data sheet of the microcontroller.

2.5 Dimensions
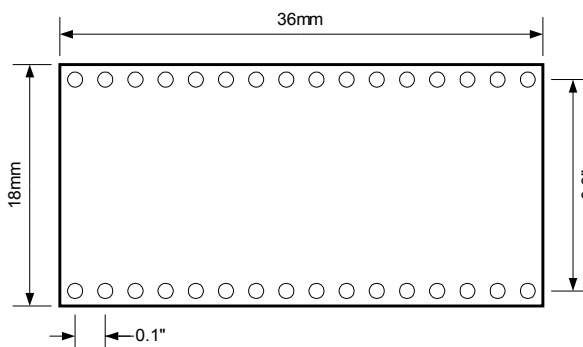
3. Application Notes

3.1 Power Supply Options

The module can be supplied by USB bus power or it can be self powered.

For bus powered supply with 5V, only a few connections are necessary.

For bus powered supply with 3.3V, also a few connections are necessary. The internal 3.3V reference of the microcontroller is used as voltage source.

For self powered supply with 5.0V a stabilized supply voltage of 5.0V is required. Use the circuitry as shown.

For self powered supply with 3.3V (3.0V to 3.6V) a stabilized supply voltage of 3.3V (3.0V to 3.6V) is required. Use the circuitry as shown. Note, that the supply is connected to UCAP and UVCC is leaved open!

5V bus powered	3.3V bus powered	5V self powered	3.3V self powered
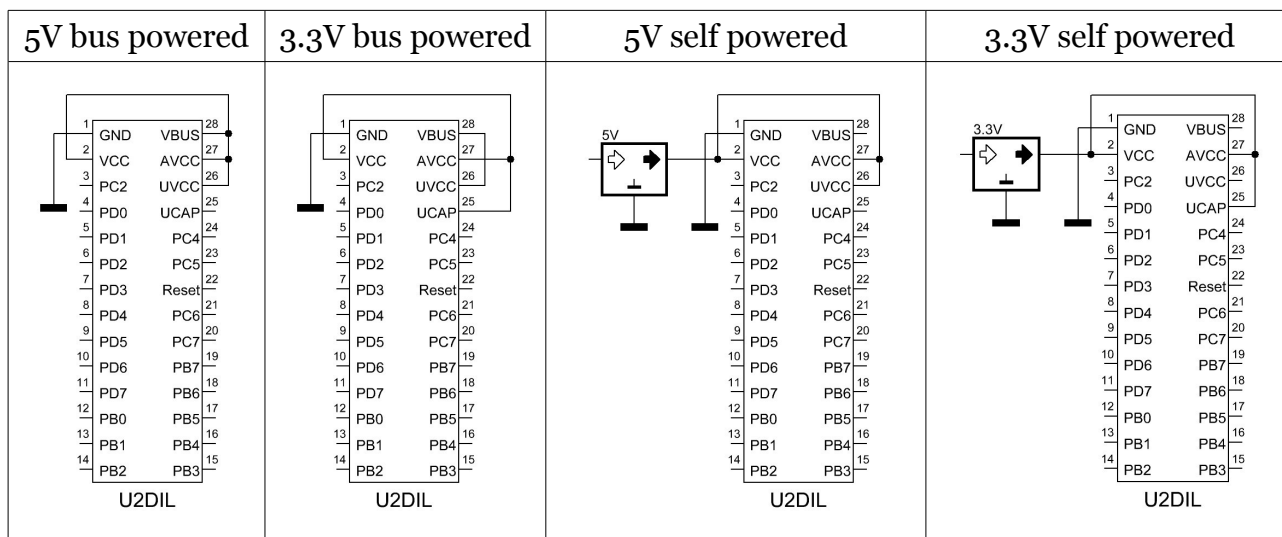
For further information please refer to the Atmel data sheet of the microcontroller.

3.2 USB plug detection

The following information is only considerable for self powered applications.

The AT90USB82/162 and the ATMEGAxxU2 models don't have the ability, to detect a plugged USB connector, that means, the VBUS voltage is present or not. An unused port can be used, to close this gap. Connect the VBUS pin with a port pin. A pull down resistor should be placed, because the VBUS pin is open (high impedance) without connection. The following example uses port PC4 as detection input. If the microcontroller is supplied with 3.3V, a voltage divider is required, as shown in the 2nd picture.
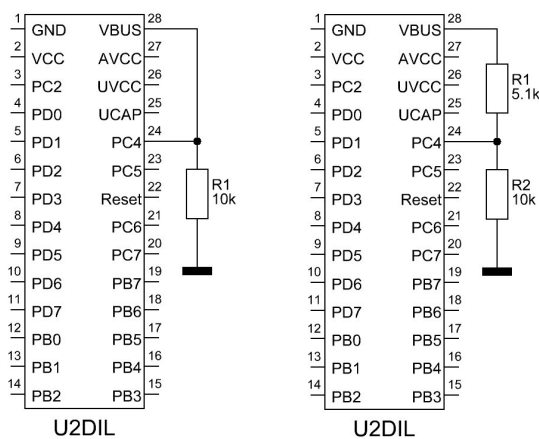
3.3 Memory Programming

The Atmel microcontroller contains an USB bootloader as factory default. So there are three ways, to program the flash memory and EEPROM of the microcontroller.

3.3.1 Bootloader and Flip

The USB bootloader, flashed as factory default, and the Software "Atmel Flip" (for *Microsoft Windows* ®) can be used, to program the microcontroller over the USB interface without special programming device. Install the "Flip" software package, before connecting the module in bootloader mode first time. The software requires the *LibUSB-Win32* drivers, which comes with the Atmel Flip installation package.

The USB bootloader will be executed, when the $\overline{\text{HWB}}$ pin (pin 11 of U2DIL module) is set to low level (0 Volt) and a reset is done (low pulse at pin 22 of U2DIL module). The module has to be connected to the personal computer (running "Microsoft Windows") via USB. Note: The module has to be clocked with 8 or 16MHz!

The module will be detected as Atmel device. The driver installation dialogue will be shown at the first time. Chose "automatic installation", if the LibUSB-Win32 drivers are already installed. Start the "Flip" application. Chose the device (ATMEGA32U2 or AT90USB162) and the hex file for programming, finally open an USB connection. Now the microcontroller can be erased, programmed and verified. The $\overline{\text{HWB}}$ pin has to be set to high level, *before* the loaded application will be started. It might be necessary, to replug the device (turn off and on the power) for proper USB operation! Note: It isn't possible, to delete the bootloader or modify any fuses with "Flip".

The "Atmel Flip" installation package can be downloaded from the Atmel homepage. Search for "FLIP" or try the following link:

http://www.atmel.com/dyn/products/tools_card_mcu.asp?tool_id=3886

3.3.2 In-System-Programming

The U2DIL module contains an Atmel ISP connector for in-system-programming. An Atmel ISP compatible programming device (such as "AVRISP MKII") is required. The advantages of this programming method:

- full control over the microcontroller, all memories and fuses
- comfortable integration into "AVR Studio"
- no bootloader required
- suitable for any clock frequency

Note: For the first programming by ISP an "erase device" is necessary, to reset the fuses. This will also erase the factory default bootloader! That means, the device no more can be programmed with "Atmel Flip", until the bootloader (or another) is reflashed!

3.3.3 Debug Wire

Pin 22 of the U2DIL module is the $\overline{\text{Reset}}$ and the "debug Wire" pin. The dW pin can be used for programming and debugging within the development environment (AVR Studio). A JTAG device with "debug Wire" support is required.

3.3.4 High Voltage Programming

Because the pin assignments of the U2DIL module doesn't correspond with the pinout of the ATMEGA32U2/AT90USB162 chip, an adapter is required, if a parallel programming is intended. Please note: A high voltage programming is not tested and will avoid warranty!

4. Concluding Remarks

4.1 Application Software

You will find programming and application sample software on the product homepage. Please visit the following URL:
http://products.reworld.eu/u2dil.htm

You will find additional information and tools on the following URLs.

Atmel AVR Tools and Software:
http://www.atmel.com/dyn/products/tools_mcu.asp?family_id=607

Dean Cameras LUFA (Lightweight USB Framework for AVRs, formerly known as MyUSB):
http://www.fourwalledcubicle.com/LUFA.php

Teensy USB Development Board:
http://www.pjrc.com/teensy/

4.2 Links

Visit the following links for more information and downloads about this product, used software modules and tools.

Reusch Elektronik homepage for electronic products:
http://products.reworld.eu

Atmel Corporation, AVR data sheets:
http://www.atmel.com/dyn/products/datasheets_mcu.asp?family_id=607

V-USB, Virtual USB Port for AVR microcontroller:
http://www.obdev.at/products/vusb/index.html

WinAVR, GCC development environment:
http://winavr.sourceforge.net/

LibUSB-Win32, USB drivers for Microsoft Windows ®:
http://libusb-win32.sourceforge.net/

4.3 Statement and Disclaimer

This electronic device is designed under best known engineering guidelines. It confirms the appropriate design rules. No warranty or liability is given for adherence, assured properties, or damages which might be caused by the usage of this hardware or the accessory software.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy, and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

4.4 Technical Support

We hope you'll understand, that technical support by phone is not possible. If You have any questions, technical problems or You need information about other products from *Reusch Elektronik*, please contact us by e-mail or Fax.

E-Mail: support@reusch-elektronik.de

FAX: +49-7541-81483

We are able to handle inquiries in english and german language.

Don't hesitate to contact us, if You have demand for custom specific solutions!