

USB Radio Clock

Rev. 1.0



Construction Manual

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Homepage:

<http://re.reworld.eu/en/products/usbdcf77/>

Created: 2009-08-14
Last change: 2009-12-04

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Reusch Elektronik
Dipl.-Ing. (FH) Rainer Reusch
Blumenstrasse 13
D-88097 Eriskirch
Germany

Homepage:
<http://www.reusch-elektronik.de>

E-Mail:
info@reusch-elektronik.de

1. Introduction

The *USB Radio Clock* is a compact gadget to adjust the real time clock of any personal computer with the operating system “Windows”. The *USB Radio Clock* is only designed for this purpose, so there is abandoned for a display. Only a two colour LED shows the signal receiving situation. The features of this USB radio clock:

- connection to PC and powered via USB interface
- precisely time based on DCF77 (Mainflingen near Frankfurt/Main, Germany)
- precisely time at power on and when no DCF77 signal available through battery buffered internal real time clock (always synchronized on available signal, when powered)
- ability to measure backup battery voltage
- a comfortable software for Microsoft “Windows” for automatic synchronization of the system time

“Real time clock” and “battery voltage measure” are available in the full equipped gadget. In options, this equipment can be omitted.

This manual describes, how to mount Your “USB Radio Clock” kit. Only conventional (wired, no SMD) parts are used, so only an ordinary soldering iron for electronic devices is required. The assembling of this kit is not difficult, but you should have some experience in assembling electronic gadgets. Note, that Reusch Elektronik can't give any liability for proper working. Please buy the professional assembled and approved gadget, if you are not confidential in your own purposes.

2. Parts of the Kit

2.1 Bill of Material

The kit should contain the following parts. Please check, before you start assembling.

Pcs.	Part	Comment	bag
2	Resistor 68Ω		1
1	Resistor 120Ω		1
1	Resistor 150Ω		1
1	Resistor 1.5kΩ		1
2	Resistor 2.7kΩ		1
2	Resistor 4.7kΩ		1
1	Resistor 5.6kΩ		1
3	Resistor 10kΩ	4 pcs. with DCF module from Conrad	1
1	Resistor 33kΩ		1
1	Resistor 100kΩ		1
1	Resistor 120kΩ		1
2	Ceramic capacitor 22pF		1
1	Foil capacitor 15nF		1

4	Ceramic capacitor 100nF		1
2	Electrolytic capacitor 10 μ F/16V		1
1	Electrolytic capacitor 47 μ F/16V		1
1	Inductor 10 μ H		1
2	Schottky diode BAT43	or BAT42	2
1	Suppressor diode P6KE6V8A		2
4	Diode BAW76		2
1	LED L-59EGW	green/red, 20mA, common cathode	2
1	FET BSS110	or BS250	2
1	Transistor BC548B	or BC237, BC238, BC547	2
2	Transistor BC307A	or BC308, BC557, BC558	2
1	Integrated circuit DS1337		2
1	Integrated circuit ATTINY861-20PU	programmed with firmware	2
1	Integrated circuit TS2950CT-3.3	or LE33CZ	2
1	Miniature crystal 32.768kHz	6pF	2
1	Crystal 12.000MHz		2
1	DIL socket 8 pin		2
1	DIL socket 20 pin		2
1	10 pin boxed header		3
1	USB-B connector		3
1	2 pin header		3
1	3 pin header		3
1	Pin header bridge		3
1	Battery holder CR2032		3
1	DCF77 module	Various models possible	3
1	Mounting and connecting material for DCF module		3
2	Rubber rings for mounting DCF77 antenna		3
10cm	Copper wire 0.8mm		3
1	Lithium battery CR2032		4
1	PCB EPR0903		4
1	Casing Teko TB7, white	Includes 4 long sheet metal screws	4
4	Sheet metal screws	mounting PCB	4
4	Rubber feets		4
1	USB cable A-B, 3m, USB-HiSpeed		0

2.2 Parts List

Assemble the PCB with the parts in the order, shown in the following table.

No	Name	Value	Casing	Alternative	Option
1	R1	100k	_0207		B
2	R2	10k	_0207		A
3	R3	4,7k	_0207		A
4	R4	4,7k	_0207		A
5	R5	10k	_0207		
6	R6	33k	_0207		B
7	R7	10k	_0207		B
8	R8	120k	_0207		B
9	R9	5,6k	_0207		B
10	R10	2,7k	_0207		
11	R11	2,7k	_0207		
12	R12	150	_0207		
13	R13	120	_0207		
14	R14	1,5k	_0207		
15	R15	68	_0207		
16	R16	68	_0207		
17	R17	10k	_0207	(only with Conrad module)	2
18	C1	15n/Foil	Grid 0.2"		B
19	C2	100n	Grid 0.1"		A
20	C3	100n	Grid 0.1"		
21	C4	22p	Grid 0.1"		
22	C5	22p	Grid 0.1"		
23	C7	100n	Grid 0.1"		B
24	C8	100n	Grid 0.1"		
25	C6	10µF/16V	Grid 2mm		
26	C10	10µF/16V	Grid 2mm		
27	C9	47µF/16V	Grid 2mm		
28	D1	BAT43	DO35	BAT42	A
29	D2	BAT43	DO35	BAT42	A
30	D4	BAW76	DO35		
31	D5	BAW76	DO35		
32	D7	BAW76	DO35		
33	D8	BAW76	DO35		
34	D6	P6KE6V8A	CB417		
35	L1	10µH	Grid 0,5"		B

36	Q1	32,768KHz	Mini quartz	6pF	A
37	Q2	12MHz	HC-49/U		
38	T1	BSS110	TO92	BS250 or similar, mount 180° turned	B
39	T2	BC548B	TO-92	BC238 or similar	B
40	T3	BC307A	TO-92	BC558 or similar	
41	T4	BC307A	TO-92	BC558 or similar	
42	IC3	TS2950CT-3.3	TO92	LE33CZ, LP2950-33	
43	IC1	DS1337	DIL8		A
44	IC2	ATTINY861-20PU	DIL20	programmed with firmware	
45	J1	Maintenance			
46	J2	RTC			A
47	K1	ISP	10 pin boxed header	ISP	
48	BAT1	CR2032	Battery holder	CR2032V direct soldered	A
49	D3	L-59EGW	Grid 0.1"	Duo-LED (red/green), 5mm, 20mA	
50	K3	USB-B			
52		DCF77-Module			1, 2, 3

Casing: Teko TB7, white

PCB: EPR0903 (Reusch Elektronik)

Hints:

For IC1 use a 8 pin socket with precision contacts.

For IC2 use a 20 pin socket with precision contacts.

Fix the DCF77 antenna with two rubber rings (inner diameter approx. 7mm). The two rings will be mounted on the PCB with soldered copper wire.

The LED (D3) has to be assembled vertical with the correct height.

The PCB will be mounted in casing with four sheet metal screws.

3. Suitable DCF-Modules

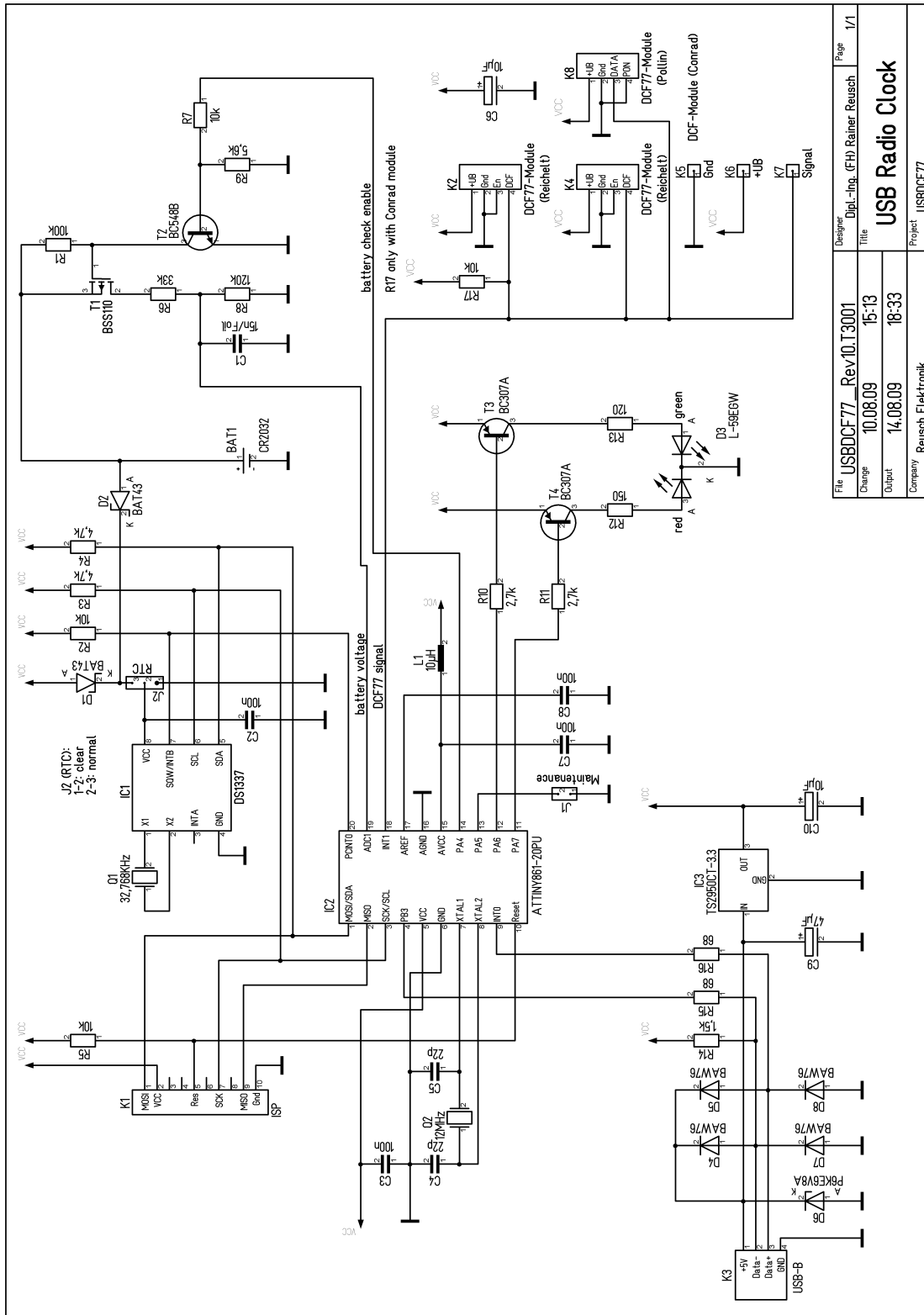
The PCB allows the mounting of the following DCF77 receiver modules:

- Reichelt, order number "DCF77 MODUL" (Option 1)
- Conrad, order number 641138 (Option 2)
- Pollin, order number 810054 (Option 3)

All modules are suitable, which fulfils the following conditions:

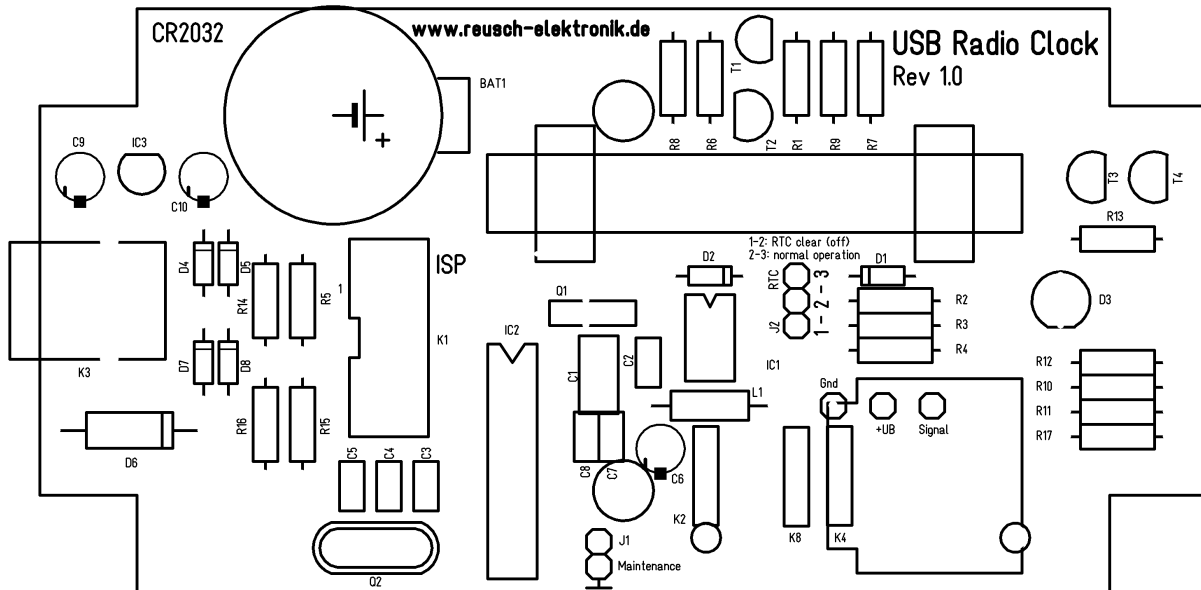
- supply voltage: 3.3 Volts
- supply current: less than 20mA
- demodulated DCF77 output signal
- non inverted output signal (can be open collector)
- suitable in dimensions

4. Schematic

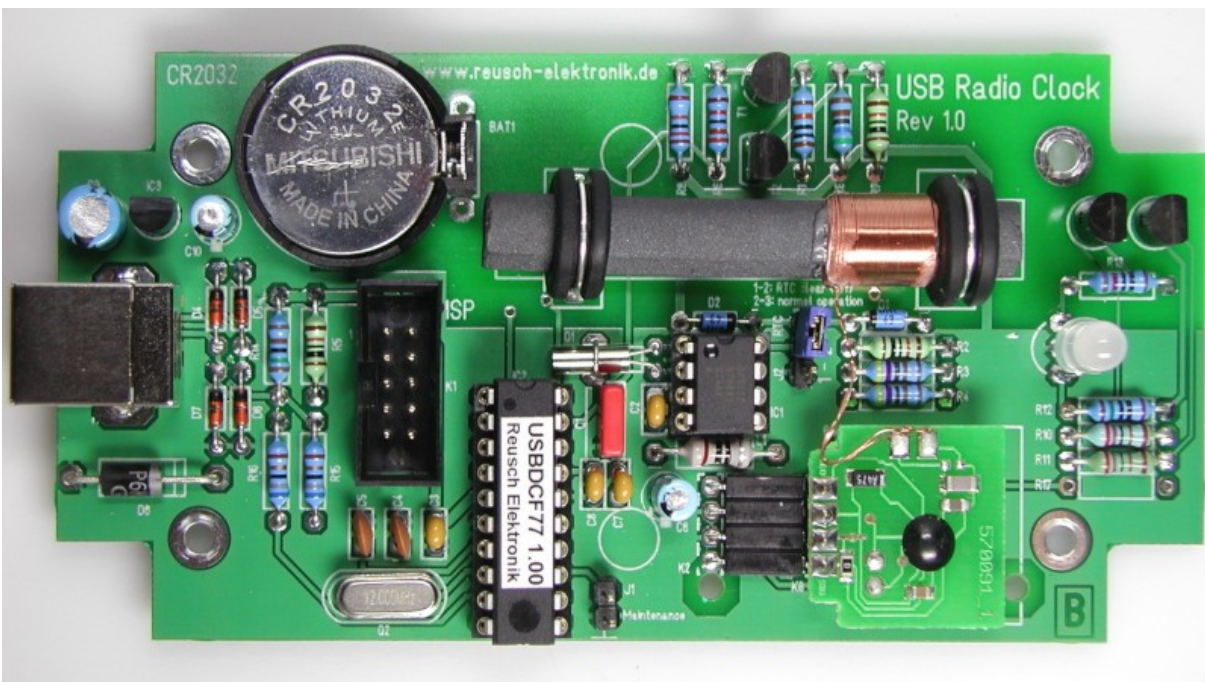


File	USBDCF77_Rev10.T3001	Designer	Dipl.-Ing. (FH) Rainer Reusch	Page	1/1
Change	10.08.09	15:13			
Output	14.08.09	18:33			
Company	Reusch Elektronik		Project	USBDCF77	
USB Radio Clock					

5. Parts Placement

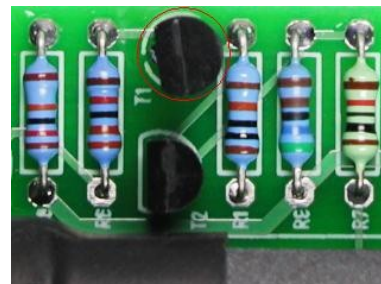


The following picture shows, how your assembled board should look like (with Reichelt module).



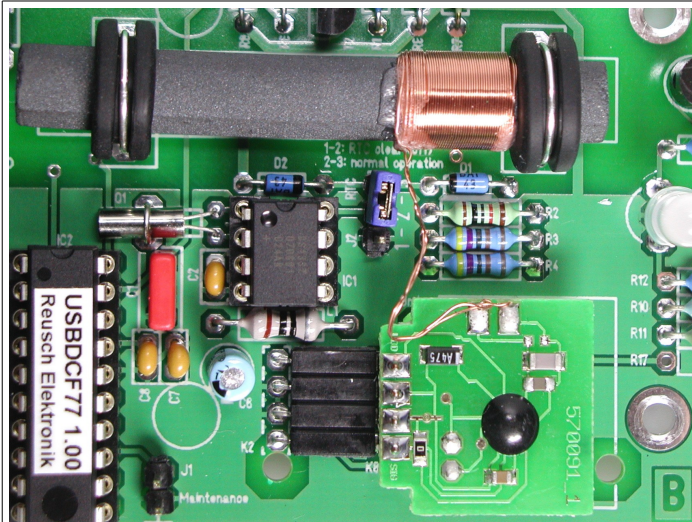
Important hint for board revision 1.0:

Please place transistor T1 turned with an angle of 180°, as shown in the picture right! The placement of T1, shown in the pictures above, is wrong!



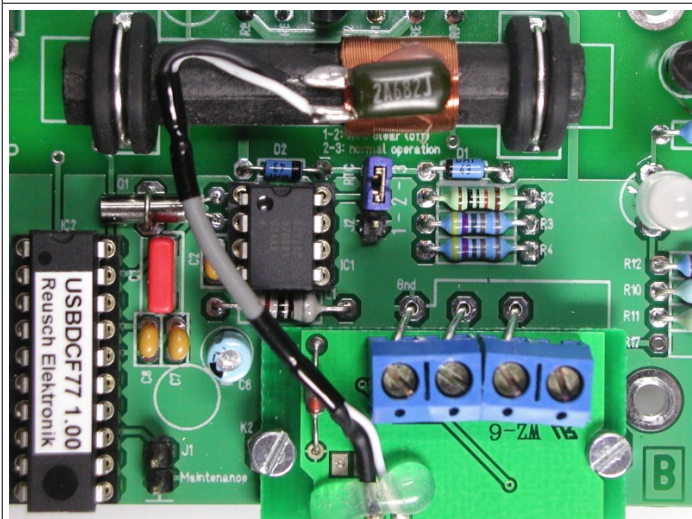
6. DCF Module Placement

The board is prepared to mount three types of DCF modules. Of course: only one module can be assembled!



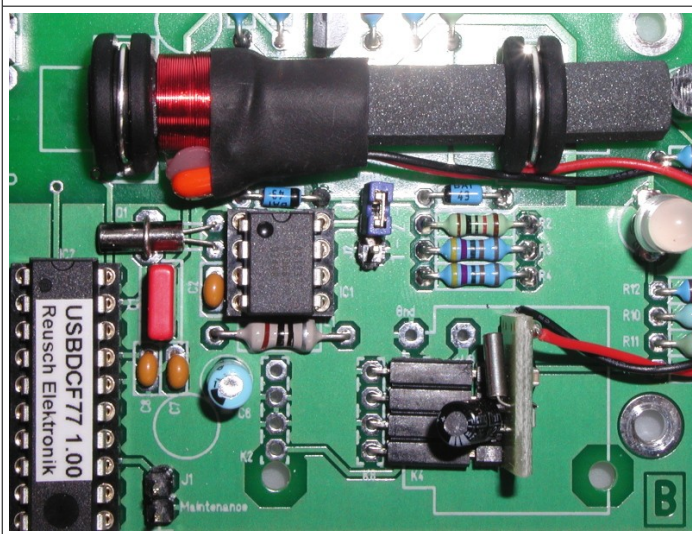
Reichelt Module

For this module the connectors K2 and K4 are reserved. Use K4 for direct mounting with four short pieces of wire. K2 is designed to use a 4 pin connector (as shown in the picture). Mount the module that the parts side is the upper side. R17 will be omitted.



Conrad Module

For this module the connector pins K5 (Gnd), K6 (+U_B) and K7 (non inverted Signal) are reserved. Use three short copper wires (0.8mm) to connect the module. The board has two 2.5mm holes to mount the module with two screws. This module type has an open collector output, so R17 has to be assembled (missing in the picture).



Pollin Module

For this module type connector K6 is reserved. An angled four pin female connector can be used, as shown in the picture. Note, that this module has another pin assignment as the Reichelt module! R17 will be omitted.

Other modules

For other modules (see 2.) one of the upper described connectors has to be used. Choose the best fitting and suitable.

7. Design Variations

The *USB Radio Clock* design allows three variations of equipment. If you don't need all features (e.g. the real time clock), you can omit all devices, required for this functionality. See also parts list (2.2), column "option". The following design variations are possible:

7.1 Full Equipment

In this design the full functionality is given. That means:

- DCF time module
- battery buffered backup real time clock
- ability, to measure battery voltage

For this design option all parts has to be assembled on the PCB (only R17 depends on chosen DCF module).

7.2 No Battery Voltage Measure

In this design option it will be abandoned for the ability to measure the battery voltage. In this option all parts, characterised as "Option B" can be omitted.

7.3 No Real Time Clock

In this design option there will be abandoned for the real time clock. That means, that no valid time is available at power up (at least one full minute has to be waiting for, until radio clock time is available). If you abandon this feature, it is not necessary to measure the battery voltage! In this option all parts, characterised as "Option A" and "Option B" can be omitted.

Note:

When the gadget is finished, use the *USB Radio Clock Serialization Software*, to configure the device, depending on the equipment.

8. Starting Up

Before You connect to power, please check for the correct equipment (especially the electrolytic capacitors) and for perfect solders.

For start up don't use an USB plug, which is directly from the root hub. To prevent damages of the computer main board, use an USB hub!

8.1 First Test and Startup

For a first test you can leave out IC1, IC2 and the DCF module (if a disconnectable line is used). Also the battery can be left out. Now execute the following steps:

1. Connect the USB cable.
2. Measure internal supply voltage (Pin 8 of IC1 or Pin5 of IC2). It should have a value about 3.3 Volts.
3. The LED should be off.
4. Current consumption should be only a few milliamperes.
5. If Your running "Windows" wants to install driver files for a new found device, please cancel.
6. Unplug the USB cable.

8.2 Final Test and Installation

For the final test all necessary parts (IC1, IC2 and DCF module) are set on the PCB. Please install the Windows software package before testing (so the required driver files are available).

1. If the real time clock is equipped, a few less voltage as the battery voltage should be measured at pin 8 of IC1 (more than 3 Volts with a fresh battery). Note, that a jumper has to be placed on J2, between pins 2 and 3.
2. Connect the USB cable
3. Your running "Windows" should view the dialogue for a new found device. Ignore it in this moment, but don't cancel!
4. The LED should light, or flash if a DCF77 radio signal is receiving.
5. If available, start the "Windows" application *USBView*. An USB device named "USB DCF77 Clock" should be found in the list of devices.
6. Now install the device in "Windows" (driver files). That means: continue the shown dialogue. Take the path, which were be chosen at software package installation, as the path with the driver files (manual selection of driver file path).
7. Execute the *USB Radio Clock Serialization Tool*. Open the device (usually with the serial number "00000000"). Set up the equipment and choose a new serial number.
8. Replug the gadget. The driver installation dialogue will be prompted again, when you have set a new serial number. Now You can choose the automatic driver installation (the necessary driver files are copied into the "Windows" directory in the step before).

Now the gadget is ready to use with the main application (*USB Radio Clock TNA Application*).

9. Links

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

Reusch Elektronik electronic product home:

<http://products.reworld.eu>

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/>

10. Statement and Disclaimer

This electronic device is designed under best known engineering guidelines. It confirms the appropriate design rules, when properly assembled. 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.

Please note, Reusch Elektronik doesn't liable for any damages, which will stay in context with this gadget! You assemble, start up and use your gadget at your own risk! If You don't have the qualification to assemble electronic devices, please contact somebody, who is able to do this in a professional way! Reusch Elektronik offers also assembled and ready to run gadgets with warranty (see homepage).