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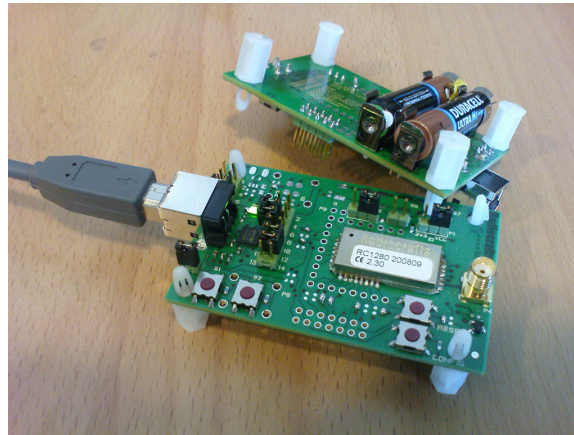
RCxxxxDK-USB

RCxxxxDK-USB Demonstration Kit User Manual

Table of contents

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RCxxxxDK-USB

Quick Start Guide

How do I set up a simple link between the boards?

To do a basic communication test, do like this for each of the Demonstration Boards:

- Attach the antenna to the SMA connector
- Download the latest version of RCTools from www.radiocrafts.com
- Install RCTools (this will also install the USB VCP (Virtual COM Port) driver)
- Connect the USB port to a PC
- Start a terminal program on the PC (RC_CCT or Microsoft HyperTerminal program)
- Select the correct COM-port and set data rate 19200, 1 start bit, no parity, 1 stop bit, no flow control

The module will now be in idle mode listening for a valid data packet to arrive. Now you can enter data in one terminal window and after a predefined timeout, the ASCII string is transmitted to the other module and shown in the other terminal window if the transmission was successful.

How do I find the COM Port to use?

A list of all available COM-ports on your PC is found from the Windows Device manager. This is opened by "Start->Run" and type "devmgmt.msc". Alternatively, Open "System" from "Control Panel" and select the Hardware tab and click on the Device Manager button. In The Device Manager you can expand the "Ports (COM & LPT)" tab to get the list of both Standard COM ports and USB COM ports connected to your PC. For details please see the Installation Guide.

How do I go on and change the RF channel or any other parameter?

To change configurable parameters, assert the CONFIG pin (pulling low by pressing CONFIG-button, see Figure 1), and send the command string using the same serial interface as for transmitting data. Parameters can be changed permanently and stored in non-volatile memory in the module. See the User Manual for the CCT software for details on how to change settings by using this tool. The details for the configuration memory contents can be found in the RC232 User Manual and the MBUS User Manual respectively.

Why is it an USB connector when the Radiocrafts modules use a serial UART?

The benefit of USB is that power is available from the Port. The RCxxxxDB has an USB to UART converter from FTDI that includes a Virtual COM Port (VCP) driver that allows you to use the demo boards with any PC software that originally require a serial COM port. This means that the PC will communicate with the module using a serial connection via the virtual COM port. Both standard terminal program and the RCTools PC suite from Radiocrafts can for this reason be used together with the RCxxxxDK-USB. For simplicity it is recommended to first use the RCTools from Radiocrafts since the USB VCP driver is included in this installation. Details on how to use this software is available from separate User Manuals.
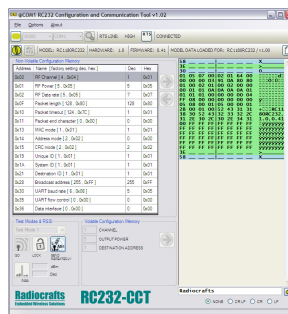

Figure 1: RC232-CCT, one of the applications in RCTools

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Demonstration kit Introduction

The Demonstration Kit (DK) is designed to make it easy for the user to evaluate the onboard module, develop an application and build prototypes very quickly. The kit includes either two Demo Boards (DB) or three DBs (for TinyMesh kits). The demo board contains the selected module with its dedicated article number and embedded protocol and associated support circuits. The board can easily be operated using a PC terminal emulator or the RCTools PC suite from Radiocrafts.

Your Demonstration Kit should contain the following items:

Kit contents	
Item	*Number of articles*
Demo board w/radio module	2
Antenna, 50Ω quarter-wave monopole, SMA male connector	2
SMA to BNC adapters	2
USB Cable	2

For TinyMesh^{TM} demo kits, the number of articles is 3 of each item.
There are three different assemblies of the demo board referenced in the rest of this document depending on the article number on the onboard RF module as summarized in the table below:

Demo Board	RC11xxDB-USB	RC12xxDB-USB	RC2xxxHP-DB-USB	RC16xx-DB-USB
Supported Modules	RC11x0-RC232 / -TM	RC1040, RC1081	RC2500HP-RC232 / -TM	RC1682-SIG
	RC11x0-MBUSx / -KNXx	RC12x0, RC1244		
	RC2500-RC232 / -TM	RC2000, RC2100		

This User Manual describes how to use the Demonstration Kit and provides detailed documentation for the Demonstration Board.

The Demonstration Kit includes what you need to evaluate the RF performance of the modules, develop your own application interfacing the modules, and can also be used to build a prototype of your application.

Demo Board Introduction

The Demo Board contains USB connector, USB to serial converter, buttons, LEDs, voltage regulator, configuration jumpers and connectors to make it easy to interface the onboard module with various test equipment or the host used in an application. Not all components are needed in an actual application. Please see the datasheet for each specific module for a typical application circuit.

The Demonstration Board comes in different versions, equipped with the different variants of Radiocrafts modules. Among the frequencies supported are 433 MHz, 865 MHz, 868 MHz, 915 MHz and 2.45 GHz. For each frequency there exist narrowband versions and wideband versions. This covers the most used frequency bands, the 433 MHz band in Europe and the US, the 865 MHz band in India, the 868 MHz band in Europe, the 902-928 MHz band in the US and the 2 450 MHz band world-wide. The actual module mounted can be seen on the marking on the module itself.
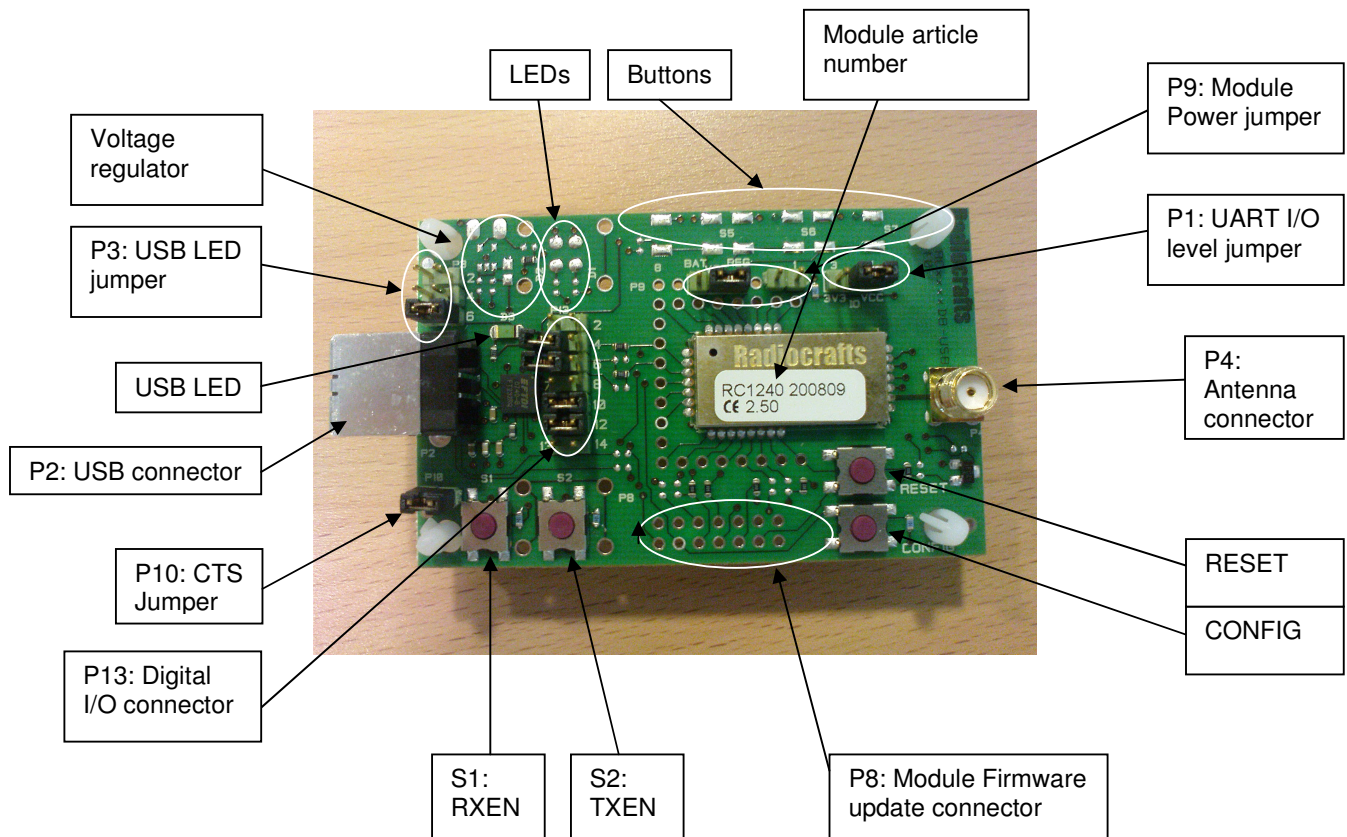
Figure 2: RCxxxxDB-USB Demonstration Board

Block Diagram

The same PCB is used for all modules previously mentioned. The component assembly is however different depending on which module is mounted. The block diagrams in figure 3 to 5 informs about actual parts used for a given demo board.
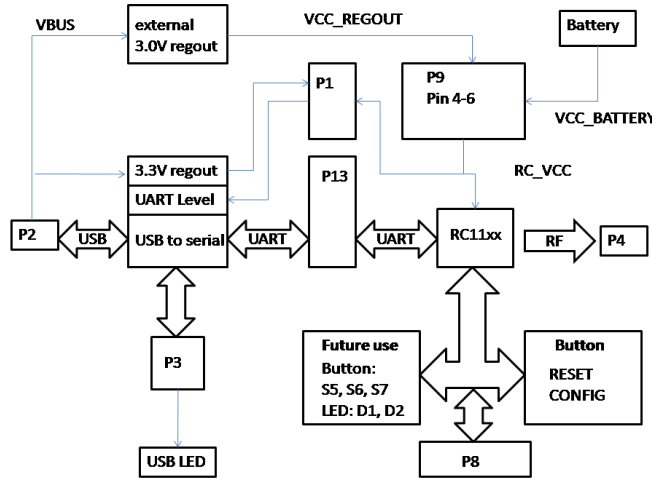

Figure 3: RC11xxDB-USB

LED D1 and LED D2 are activated on Demo Boards with TinyMesh protocol. See TinyMesh Data Sheet for details.
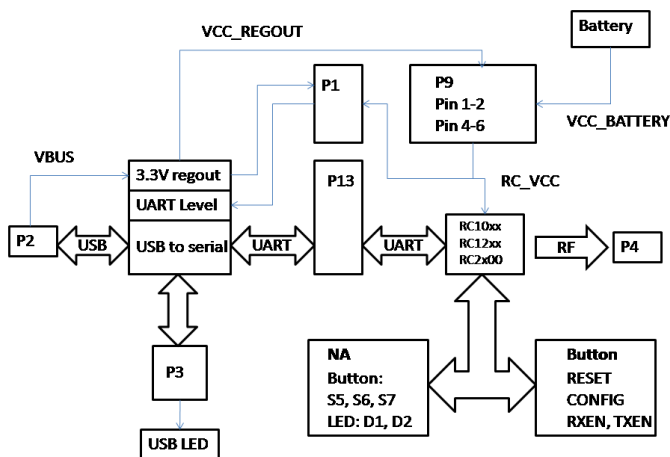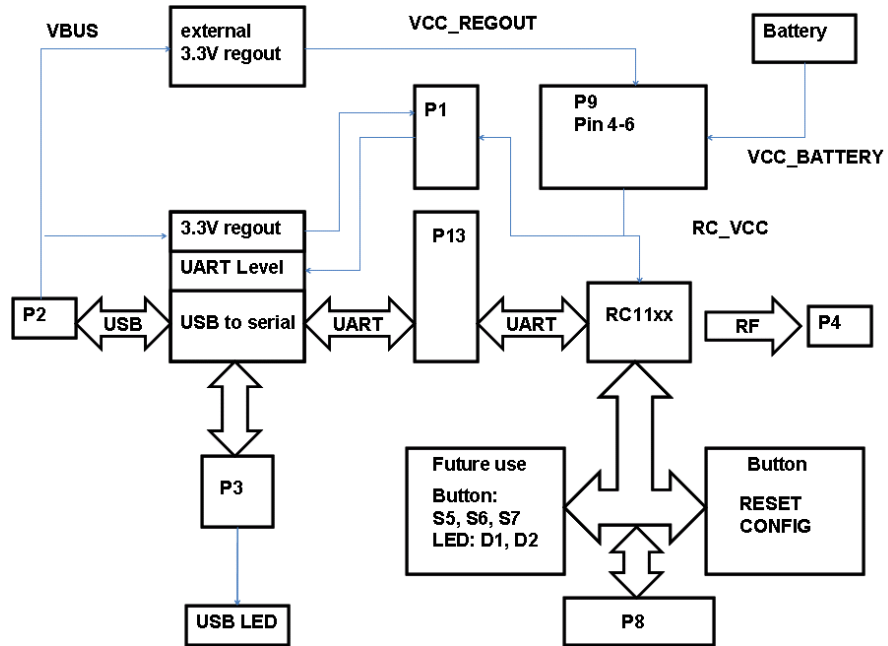

Figure 4: RC12xxDB-USB

Figure 5 RC2xxxDB-USB
(only different external voltage regulator compared to Figure 3)

LED D1 and LED D2 are activated on Demo Boards with TinyMesh protocol. See TinyMesh Data Sheet for details.

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Jumper section

The board contains several jumper options for connector P1, P3, P9, P10 and P13. The connectors and jumper settings are summarized in this chapter.

P1: UART voltage level jumper		
Pin #	**Signal**	**Note**
1	RC_VCC	Module Power.
2	VCCIO_FT232	VCCIO_FT232 Sets the UART voltage level for the USB-UART converter and provide power to the USB LED. Must not exceed more than RC_VCC+0.3V. Connect to pin 1 if external power source on RC_VCC is used and RC_VCC<3.0V. Due to noise from USB-UART converter to the Radio, this setting can give sensitivity degradation and increased packet loss on high signals. Connect to pin 3 if RC_VCC>3.0V (RC_VCC is always 3.3V when board is powered by the USB). Use this setting for range and sensitivity testing in order to get best performance. Remove jumper when measuring SLEEP and OFF current in order not to include leakage current from the USB chip UART.
3	3V3	3.3V regulator output from USB-UART converter.

P3: USB LED Jumper			
Pin #		**Signal**	**Note**
1	2	TXD Data	Install jumper to enable LED blink when data on UART RXD. RF transmit mode
3	4	RXD data	Install jumper to enable LED blink when data on UART TXD. RF receive mode
5	6	POWER	Install jumper to enable LED when Power is available from USB **(default)**. LED current draw is typ 2.5 – 3.5 mA depending on RF module

P9: Module Power jumper		
Pin #	**Signal**	**Note**
1	GND	
2	RCxxxx pin12	RC11xx/RC2xxxDB-USB: RESET (not in use) RC12xxDB-USB: ON/OFF. Connect to pin 1 to measure OFF current drain. Note that The 100k pull-up resistor R2 will draw approximately 27 uA in OFF mode if not removed. The pull-up resistor is used to keep the module in ON mode for normal use. In a real application this pin could be controlled by a digital output, and (the pull-up) R2 could be omitted, and hence the very low OFF mode current consumption can be achieved
3	RCxxxx pin11	RC11xx/RC2xxxDB-USB: not in use RC12xxDB-USB: VDD (internal regulator out from the module)
4	VCC_REGOUT	RC11xxDB-USB: Power from external regulator (3.0V) RC2xxxDB-USB: Power from external regulator (3.3V) RC12xxDB-USB: USB chip regulator (3.3V)
5	RC_VCC	Power to the module. An ampere meter can be connected in order to measure the DC current drawn by the module. External power can also be connected to this pin. Ensure that the same level is connected to P1 pin 2.
6	RC_BATTERY	Power from battery on the bottom side
7	VCC_REGIN	Input to external regulator
8	VBUS	Power from USB port

As described in the table above, the RC11xx/RC2xxxDB-USB series has a different component assembly compared to the RC12xxDB-USB for P9. Connector and default jumper settings are illustrated below for the two different assemblies.
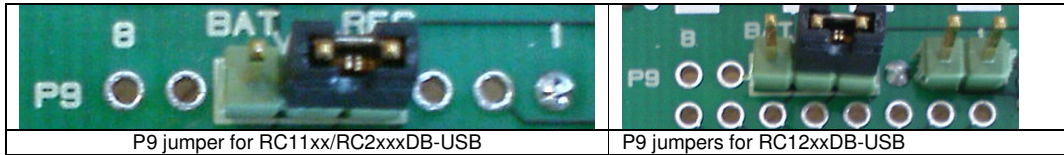

P9 jumper for RC11xx/RC2xxxDB-USB	P9 jumpers for RC12xxDB-USB

Figure 6: RCxxxxDB-USB P9 assembly and default jumper settings

P10: CTS		
Pin #	**Signal**	**Note**
1 2	CTS	Remove jumper for enabling CTS for RC12xxDB-USB. Not in use for RC11xx/RC2xxxDB-USB

P13: Digital I/O Connector		
Pin #	**Signal**	**Note**
1 2	GND	RC11xx/RC2xxxDB-USB: Connect jumper between 2 and 4 to enter sleep mode
3 4	RTS	Install jumper when using hardware handshake
5 6	CTS	Install jumper when using hardware handshake
7 8	CONFIG	7 and 8 connected together. Connect pin 7 to pin 3 for PC control of CONFIG
9 10	TXD	Jumper installed from factory RC11xx/RC2xxxDB-USB: Remove jumper when measuring sleep mode current
11 12	RXD	Jumper installed from factory RC11xx/RC2xxxDB-USB: Remove jumper when measuring sleep mode current
13 14	GND	

Prototyping with the RCxxxxDB-USB

All pins to the module are available though standard pin rows using a pitch distance of 100 mil (2.54 mm). This simplifies the build of a standalone application just by making a small plug-in-board to the existing Demo Board. Battery connectors on the bottom side are available for self powered demos, and there is also access to VBUS (+5V), REGIN and REGOUT on P9. The Battery clips and most of the connectors are not mounted from factory, but part numbers are available from the Bill of Materials at the end of this document. The idea is that an external MCU and application specific sensors etc easily can be connected to the Demo Board as a proof of concept for the final product.

Prototyping with the MPC1 pulse counting interface

Demo Boards like the RCxxxx-MPC1-DB have embedded a pulse counting interface. These boards have an MPC-label on the bottom side.

Pulses can be generated by pressing Push Button S7. For connecting external pulse generators (e.g a utility meter with counter output) to the Demo Board, connect two wires to the board as shown below. The wires are connected to pin 26 (PULSE input) on module and ground.

The MPC1 Demo Board also has a 1 MOhm pull-up resistor connected to the pulse input, and can therefore be connected directly to any potential free switch output (open collector transistor, or reed relay).

Antenna selection versus range performance

The choice of antenna is crucial for achieving the maximum range for any radio system. Due to the small size of the PCB and the off-centre placement of the onboard SMA connector the Demo Boards will not demonstrate the maximum range or omnidirectional radiation. To improve this, a larger groundplane and a centred placement of the antenna above this groundplane is required. One possible solution for maximum radiation is shown in the figure below. With the addition of two different SMA adaptors and one sufficiently large groundplane (radius ≥ L, length of the antenna) and a good electrical connection to the GND-layer, an optimum performance of the antenna following the kit is achieved.

Other antenna solutions can be tested by connecting to the existing SMA female connector on the Demo Board via one of the methods below:

1. Solder the feeding point of the antenna to be tested directly to an SMA male connector and fasten to the SMA female connector
2. Connect to an external antenna (or board with antenna) via a shortest possible 50 Ohm coax cable with minimum insertion loss

Antenna

Antenna length L

Minimum radius of
GND plane = L

PCB with solid bottom
GND layer

SMA female/female
adaptor in drilled
hole

SMA male/male
adaptor

Radiocrafts Demo
Board

Proper connection
betwen GND plane
and adaptor outer
shielding
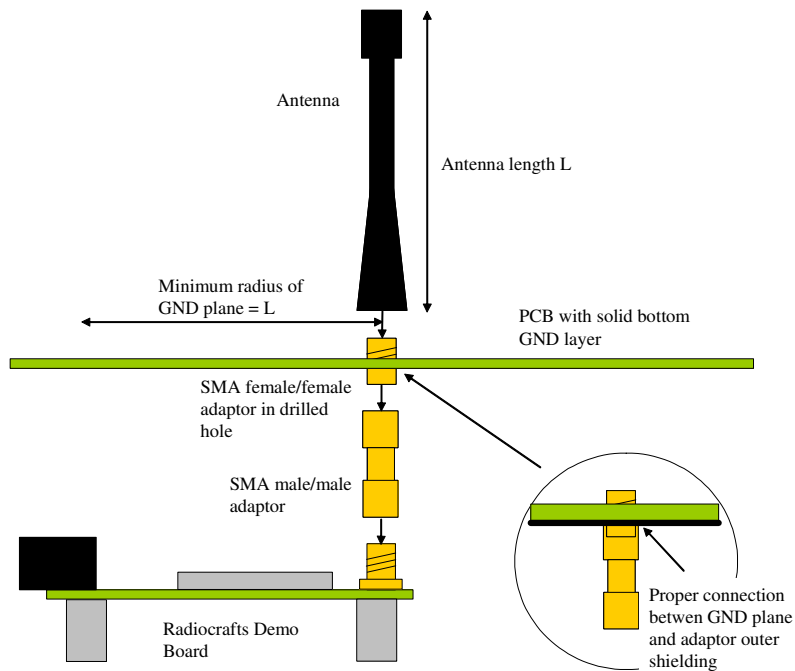
Figure 7: Extending size of ground plane with extra PCB

RCxxxxDB-USB Circuit Diagram

The circuit diagram of RCxxxxDB-USB is in figure 8. A full resolution schematic is found in RCxxxxDB_x_x.zip available from Radiocrafts' webpage.

Figure 8: RCxxxxDB-USB Circuit diagram

RCxxxxDB-USB PCB and Assembly layout

The PCB is a simple 4-layer board where Layer 2 is used as ground plane. The laminate used is standard FR-4 board material. The PCB is 1.6mm thick. Full resolution layout and assembly drawing are found in RCxxxxDB-USB_x_x.zip.

Figure 9: RCxxxxDB-USB PCB component placement, top side

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RCxxxxDB-USB Bill of materials

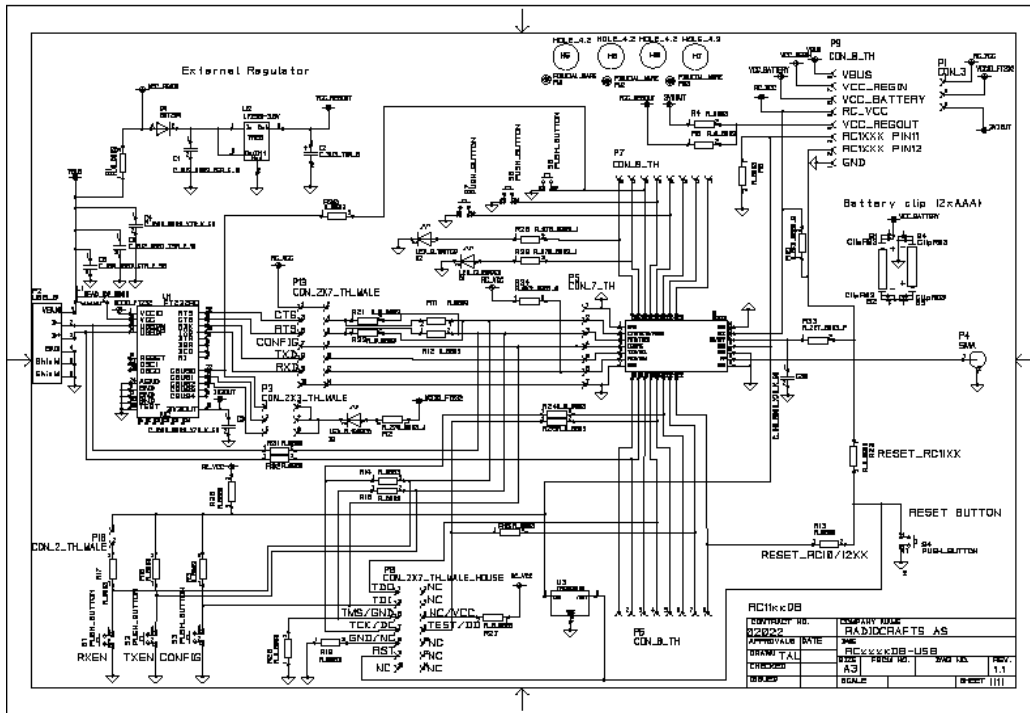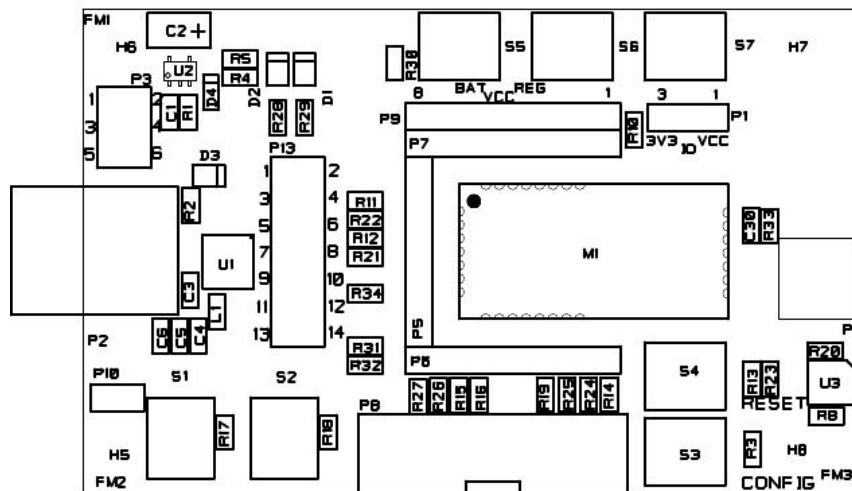The circuit diagram includes all components of RCxxxxDB-USB, but all three versions of the Demo Boards has different component bill of materials. Details are listed in the following tables. Components not mounted are marked *DNM (Do Not Mount)* in the 'Quantity' column.

RCxxxxDB-USB Bill of materials for RC11xxDB-USB			
Reference	*Quantity*	*Part number*	*Description*
D4	1	BAT254	Diode, Si
P3	1	CON_2X3_TH_MALE	Connector 6 pins, pin header
P13	1	CON_2X7_TH_MALE	Connector 14 pins, pin header
P8	1	CON_2X5_TH_MALE	Connector 10 pins
P10	*1(DNM)*	*CON_2_TH_MALE*	*Connector, 0.9 mm pin, male*
P1; P9	2	CON_3	Connector, 0.9 mm pin
P5	*1(DNM)*	*CON_7_TH*	*Connector, 0.9 mm pin*
P6-7;	*2(DNM)*	*CON_8_TH*	*Connector, 0.9 mm pin*
C3-4	2	C_100N_0603_X7R_K_50	Capacitor, 0603
C5	1	C_10N_0603_X7R_K_50	Capacitor, 0603
C1;C6	2	C_2U2_0603_X5R_K_10	Capacitor, 0603
C2	1	C_3U3_TAN_B	Capacitor, tantal
B1-4	*4(DNM)*	*ClipR03*	*Battery ClipR03 (AAA)*
FM1-3	*3(DNM)*	*FIDUCIAL_MARK*	*Fiducial mark*
U1	1	FT232RQ	USB UART IC
H5-8	4	HOLE_4.2	PCB feet
D1	1	LED_CL150DCD	LED, orange, SMD
D3	1	LED_CL150GCD	LED, green, SMD
D2	1	LED_CL150YCD	LED, yellow, SMD
U2	1	LP2980-3.0V	3.0V low drop-out regulator
L1	1	L_BEAD_102_0603	EMI filter bead
S1-2	*2(DNM)*	*PUSH_BUTTON*	*Push button, SMD*
S3-7	5	PUSH_BUTTON	Push button, SMD
M1	1	RC11XX	RF Module
R4; R11-R20; R30-32	*14(DNM)*	*R_0603*	*Resistor, 0603, general*
R1; R5; R21-27;	9	R_0_0603	Resistor, 0603
R3; R10	*2(DNM)*	*R_100K_0603_G*	*Resistor, 0603*
R2;R28-29	3	R_270_0603_J	Resistor, 0603
P4	1	SMA	SMA connector
U3	*1(DNM)*	*TPS3809J25*	*Voltage supervisor, 2.5V, SOT-23*
P2	1	USB_B	USB B-style connector

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RCxxxxDB-USB Bill of materials for RC12xxDB-USB			
Reference	Quantity	Part number	Description
D4	1 (DNM)	BAT254	Diode, Si
P3	1	CON_2X3_TH_MALE	Connector 6 pins, pin header
P13	1	CON_2X7_TH_MALE	Connector 14 pins, pin header
P8	1(DNM)	CON_2X7_TH_MALE	Connector 14 pins, pin header in house
P10; P9	2	CON_2_TH_MALE	Connector, 0.9 mm pin, male
P1, P9	2	CON_3	Connector, 0.9 mm pin
P5	1(DNM)	CON_7_TH	Connector, 0.9 mm pin
P6-7	3(DNM)	CON_8_TH	Connector, 0.9 mm pin
C3-4	2	C_100N_0603_X7R_K_50	Capacitor, 0603
C5	1	C_10N_0603_X7R_K_50	Capacitor, 0603
C1	1(DNM)	C_2U2_0603_X5R_K_10	Capacitor, 0603
C6	1	C_2U2_0603_X5R_K_10	Capacitor, 0603
C2	1(DNM)	C_3U3_TAN_B	Capacitor, tantal
B1-4	4(DNM)	ClipR03	Battery ClipR03 (AAA)
FM1-3	3(DNM)	FIDUCIAL_MARK	Fiducial mark
U1	1	FT232RQ	USB UART IC
H5-8	4	HOLE_4.2	PCB feet
D1	1(DNM)	LED_CL150DCD	LED, orange, SMD
D3	1	LED_CL150GCD	LED, green, SMD
D2	1(DNM)	LED_CL150YCD	LED, yellow, SMD
U2	1(DNM)	LP2980-3.0V	3.0V low drop-out regulator
L1	1	L_BEAD_102_0603	EMI filter bead
S1-4	4	PUSH_BUTTON	Push button, SMD
S5-7	3(DNM)	PUSH_BUTTON	Push button, SMD
M1	1	RC1XX0	RF Module
R1; R5; R11-R12; R20; R23-R32;	13(DNM)	R_0603	Resistor, 0603, general
R4; R19 R13-R16 R21-R22	10	R_0_0603	Resistor, 0603
R3;R10 R17; R18	4	R_100K_0603_G	Resistor, 0603
R2;	1	R_270_0603_J	Resistor, 0603
P4	1	SMA	SMA connector

RCxxxxDB-USB Bill of materials for RC2xxxDB-USB			
Reference	*Quantity*	*Part number*	*Description*
D4	1	BAT254	Diode, Si
P3	1	CON_2X3_TH_MALE	Connector 6 pins, pin header
P13	1	CON_2X7_TH_MALE	Connector 14 pins, pin header
P8	1	CON_2X5_TH_MALE	Connector 10 pins
P10	*1(DNM)*	*CON_2_TH_MALE*	*Connector, 0.9 mm pin, male*
P1; P9	2	CON_3	Connector, 0.9 mm pin
P5	*1(DNM)*	*CON_7_TH*	*Connector, 0.9 mm pin*
P6-7;	*2(DNM)*	*CON_8_TH*	*Connector, 0.9 mm pin*
C3-4	2	C_100N_0603_X7R_K_50	Capacitor, 0603
C5	1	C_10N_0603_X7R_K_50	Capacitor, 0603
C1;C6	2	C_2U2_0603_X5R_K_10	Capacitor, 0603
C2	1	C_3U3_TAN_B	Capacitor, tantal
B1-4	*4(DNM)*	*ClipR03*	*Battery ClipR03 (AAA)*
FM1-3	*3(DNM)*	*FIDUCIAL_MARK*	*Fiducial mark*
U1	1	FT232RQ	USB UART IC
H5-8	4	HOLE_4.2	PCB feet
D1	1	LED_CL150DCD	LED, orange, SMD
D3	1	LED_CL150GCD	LED, green, SMD
D2	1	LED_CL150YCD	LED, yellow, SMD
U2	1	LP2992-3.3V	3.3V low drop-out regulator. 250 mA
L1	1	L_BEAD_102_0603	EMI filter bead
S1-2	*2(DNM)*	*PUSH_BUTTON*	*Push button, SMD*
S3-7	5	PUSH_BUTTON	Push button, SMD
M1	1	RC11XX	RF Module
R4; R11-R20; R30-32	*14(DNM)*	*R_0603*	*Resistor, 0603, general*
R1; R5; R21-27;	9	R_0_0603	Resistor, 0603
R3; R10	*2(DNM)*	*R_100K_0603_G*	*Resistor, 0603*
R2;R28-29	3	R_270_0603_J	Resistor, 0603
P4	1	SMA	SMA connector
U3	*1(DNM)*	*TPS3809J25*	*Voltage supervisor, 2.5V, SOT-23*
P2	1	USB_B	USB B-style connector

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Troubleshooting

It doesn't work. The Power LED is not lighting.
- Is the USB connector active? Some USB ports may be disabled if it's not commonly in use. The Demo board takes power from the USB port, and need an active USB port to power the board.

- Are all jumpers placed at the default position? P3 can disable POWER LED info, and P9 can disable power to the module.

- Is the module powered correctly? Measure the supply voltage at P9, pin 5. Should be 3.0V for RC11xxDB-USB and 3.3V for RC12xxDB-USB and RC2xxxDB-USB

I cannot communicate with the UART through the serial port
- Make sure that the RXD and TXD jumpers are inserted on P13.

- Set up your terminal program according to the instructions in the Quick Start Guide. Remember to select the correct COM-port and connect to this port.

- Entering configuration mode (by press CONFIG button) the command prompt (">") should be displayed on the terminal window. Make sure to exit the command mode using the exit command (capital "X").

I cannot communicate between two modules in buffered mode
- Make sure that the address mode and CRC mode is the same in both modules (set using the "M" Memory configuration command, refer to the RC232 User Manual).

- Make sure the destination address is the same as the other modules Unique ID if addressing is used (set using the "T" Destination address command, refer to the RC232 User Manual).

- Make sure to exit from command mode using capital "X".

- The present configuration can be listed to the terminal using the test command "0" (zero).

- -SIG modules do not communicate with each other. For further details, please see the relevant User Manual.

The module consumes more than the rated current in OFF and SLEEP mode
- Note that the ON/OFF signal pull up resistor R2 (100 kΩ) draws approximately 27 uA. Remove this resistor when measuring the module current in OFF mode.

- Note that the level driver on the USB controller has common power as the module for default jumper setting. Move the jumper to the P1 2-3 location and remove P13 jumpers for RXD and TXD.

I cannot access configuration mode when I press the CONFIG button
- Press and hold CONFIG button while pushing the RESET button (or power up the board). The reason you could not enter configuration mode, is most likely that some configuration memory values have been set to illegal values. List and check all values using the '0' (zero) command. Set all values back to default values (see RC232 User Manual or the respective Data Sheet).

- Note: If the mode is already in configuration mode it will not respond with another prompt if the CONFIG button is pressed. Send the '0' (zero) command to the module in order to check if it is already in configuration mode.

Document Revision History

Document Revision	Changes
1.0	First release
1.10	Added support for RC2500 and RC2500HP. Introduced new Demo Board version supporting RC2500HP
1.11	Added information about TinyMesh and KNX RF Demo Board versions
1.12	P1 jumper setting info updated
1.13	Updated with –SIG variant
1.14	Added information on MPC1 type of modules with pulse input

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As far as possible, major changes of product specifications and functionality, will be stated in product specific Errata Notes published at the Radiocrafts website. Customers are encouraged to check regularly for the most recent updates on products and support tools.

Trademarks

RC232™ is a trademark of Radiocrafts AS. The RC232™ Embedded RF Protocol is used in a range of products from Radiocrafts. The protocol handles host communication, data buffering, error check, addressing and broadcasting. It supports point-to-point, point-to-multipoint and peer-to-peer network topologies. TinyMesh™ is a trademark of Tiny Mesh AS. The TinyMesh™ Embedded RF Protocol is used in a range of products from Radiocrafts. The protocol handles host communication, data buffering, error check, addressing and broadcasting. It supports transparent and packet-addressed mesh topologies.

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This Radiocrafts product is not designed for use in life support appliances, devices, or other systems where malfunction can reasonably be expected to result in significant personal injury to the user, or as a critical component in any life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness. Radiocrafts AS customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Radiocrafts AS for any damages resulting from any improper use or sale.

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