UM1589
User manual

M24LR-Discovery kit user guide

Introduction

The M24LR-Discovery kit helps you evaluate the M24LRXX-E Dual Interface EEPROM that features an energy harvesting analog output, as well as a user-configurable digital output.

The M24LR-Discovery kit is delivered with a battery-less M24LR board that can be powered by RFID readers or NFC phones supporting the ISO/IEC15693 protocol. It is based on an M24LR04E-R I²C - ISO/IEC15693 Dual Interface EEPROM, an 8-bit STM8L152C6T6 ultralow power microcontroller, and includes an STTS751 temperature sensor, a 24-segment LCD, and 2 push buttons.

The M24LR-Discovery kit also comes with an USB RF transceiver demonstration board that includes the CR95HF 13.56-MHz multi-protocol contactless transceiver. It is based on a 32-bit, STM32F103CBT6 performance line microcontroller and is connected to a computer host via its USB connector.

Table 1. Applicable tools

Type	Applicable tool
Evaluation tools	M24LR-Discovery kit

Figure 1. M24LR evaluation board

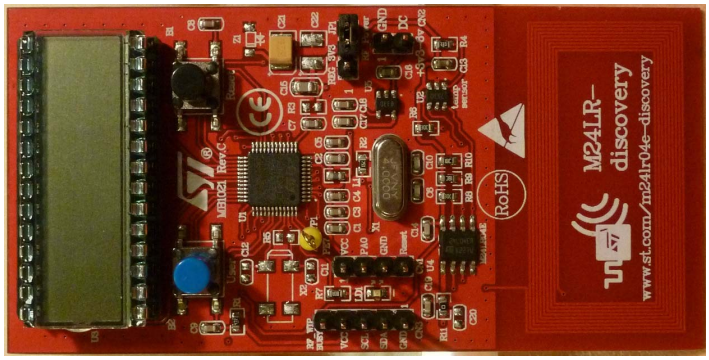
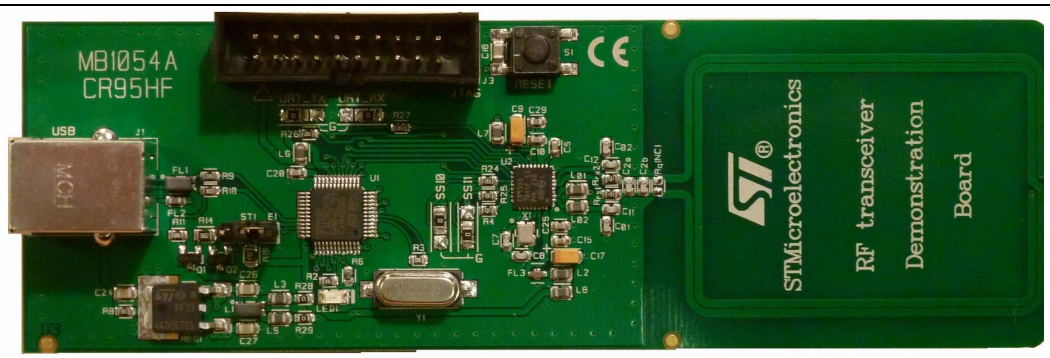


Figure 2. RF transceiver demonstration board



Contents

1 Quick start

The M24LR-Discovery kit is a low-cost and ready-to-use development kit used to evaluate the functions and performance of the M24LR Dual Interface EEPROM family and its energy harvesting capability.

For more information on the M24LR-Discovery kit and associated demonstration software, please visit www.st.com/m24lr04e-discovery.

1.1 Getting started with the M24LR04E Dual Interface EEPROM

1. On the M24LR board, ensure that a jumper is placed on connector JP1 in the RF power position (jumper on the right side as shown in *Figure 4*).
2. Download and install the M24LR/CR95HF demonstration software available at www.st.com/m24lr04e-discovery.
3. Connect the RF transceiver demo board to a PC with a USB cable.
4. Launch M24LRxx_Application_Software.exe, and select **CR95HF Demo Kit**. Then, open the **Demo NDEF messages** menu and select **Show Demo NDEF & Energy Harvesting**.
5. Place the M24LR board antenna close to the RF transceiver demo board antenna.
6. The M24LR board starts in Message Display mode (The “M24LR04E-DISCOVERY” message scrolls across the screen from right to left).

   You can read the current NDEF message stored in the M24LR04E-R by clicking the **Read NDEF message** button of the PC software.

   You can also write an new NDEF message: it will be automatically displayed on the M24LR board LCD screen after programming.
7. To change the user mode, press push button B2 (blue button on the left side of the board). *Table 2* lists the user modes available.

Table 2. Available user modes

Mode	Description
1	Displays the NDEF text message stored in the M24LR04E Dual Interface EEPROM.
2	Displays the voltage powering the M24LR board.
3	Displays the ambient temperature, measured using the temperature sensor.

To study or modify the M24LR board application project related to this demo, please visit www.st.com/m24lr04e-discovery.

1.2 Using the M24LR board with Android NFC phones

1. Enable NFC communication on your phone (Settings >Wireless and Networks>NFC).
2. Download the NfcV-Reader Application from Google Play Store.
3. Launch the NfcV-Reader application.
4. Place the phone's NFC antenna close to the M24LR board antenna.

The phone powers the M24LR board.

The text message can be changed in the M24LR04E using the NFC phone (select **NDEF function** in the NfcV-Reader application and open the **Write NDEF message** menu).

Please note that performance may vary depending on the NFC phone and its RF management system.

1.3 System requirements

- Windows® PC (XP or Vista)
- Two USB cables

1.4 Development toolchain

- Cosmic CXSTM8 compiler
- STMicroelectronics ST Visual Develop (STVD) integrated development environment
- STMicroelectronics STLINK/V2 in-circuit debugger and programmer

2 Features

The M24LR-Discovery kit includes M24LR board and the RF transceiver board which offer the following features.

M24LR board

- M24LR04E-R, a 4-Kbit EEPROM with an I²C-ISO/IEC 15693 dual interface and an energy harvesting analog output (Vout pin) and a user-configurable digital output (RF Write-in-progress or Busy pin) in an SO8N package
- 9-turn, 13.56-MHz etched antenna (20mm x 40mm) for RF powering and communication
- STM8L152C6T6, 8-bit ultralow power microcontroller with up to 32 Kbytes of Flash memory, 2 Kbytes of RAM, and 1 Kbyte of Data EEPROM in a 48-pin LQFP package
- STTS751 I²C low power temperature sensor
- 28-pin LCD on DIP24 socket (24 segments, 4 commons)
- Two push buttons (User and Reset)
- HC-49S-C20SSA, a 4-MHz crystal oscillator (not used in demonstration firmware)
- 4-pin connector (CN1) for STM8L programming and debug (SWIM)
- 2-pin connector (CN2) for external power supply source (3 to 6V)
- 5-pin connector (CN3) for M24LR04E-R and I²C bus probing
- 3-pin switch (JP1) to select M24LR board power source (M24LR04E Vout pin or external)

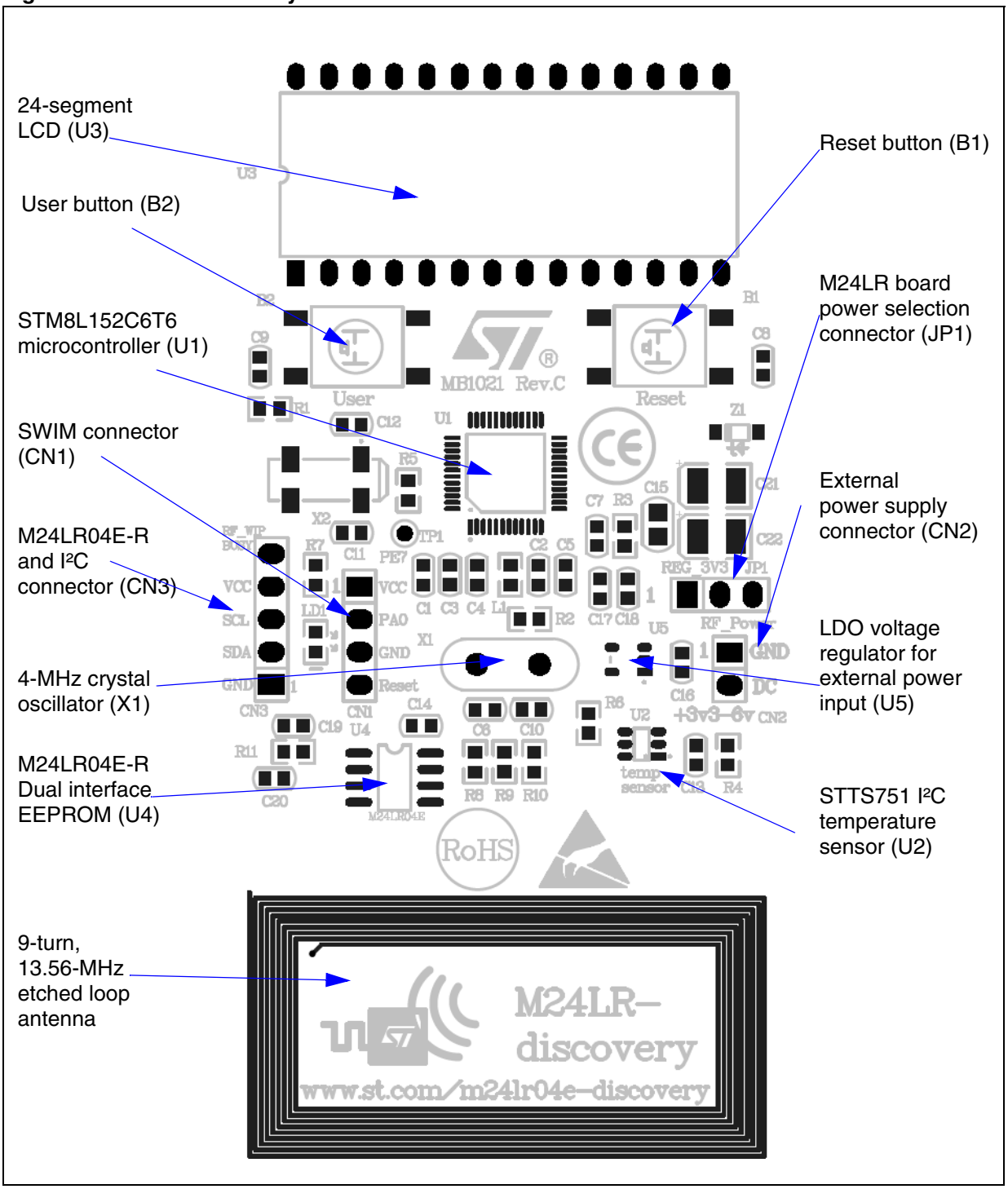
RF transceiver board

- CR95HF, a 13.56-MHz multi-protocol contactless transceiver IC with SPI and UART serial access communication
- 2-turn, 13.56-MHz etched loop antenna (47mm x 34 mm) with associated tuning circuit and lowpass filter
- STM32F103CBT6, a 32-bit microcontroller with 128 Kbytes of Flash memory and USB interface in a 48-pin LQFP package
- KF33BDT, a 3.3V low dropout (LDO) voltage regulator
- USB connector
- NX2520SA, a 27.12-MHz EXS00A-CS01206 crystal oscillator for CR95HF transceiver
- HC-49XA-C20QQA-8.000MHz for STM32
- 20-pin JTAG connector for STM32 programming and debugging
- 1 push button (Reset)

3 Hardware and layout description

3.1 M24LR board description

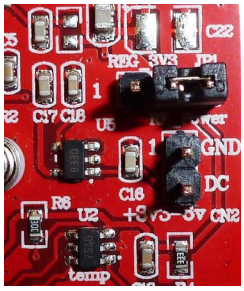
Figure 3. M24LR board layout



3.2 M24LR board power selection

When jumper JP1 is set in the “RF power” position (*Figure 4*), the M24LR board is powered by the M24LR04E-R energy harvesting analog output (Vout pin). In this configuration, the M24LR board is powered by the magnetic field flowing into its 9-turn, etched loop antenna, delivered from a 13.56-MHz RF source, such as an RFID reader or an NFC phone. The DC voltage supply delivered by the M24LR04E-R Vout pin is filtered by an 10-nF capacitor (C19) and stored in the 150-µF capacitor (C22). The low dropout (LDO) voltage regulator (U5) is bypassed, so the M24LR04E-R voltage is filtered but not regulated.

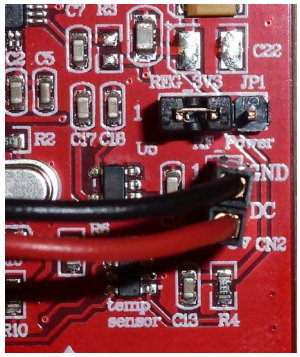
Figure 4. Jumper JP1 set in RF power position



When jumperJP1 is set in the “REG 3.3" position (*Figure 5*), the M24LR board is powered by the external power supply connected on connector CN2. The voltage applied on the external power supply connector CN2 is regulated by the 3.3V voltage regulator (U5). The external power supply voltage can be from 3.3 to 6V.

Using an external power supply is necessary when programming or debugging the STM8L MCU using the SWIM connector (CN1).

Figure 5. Jumper JP1 in “REG_3V3” position and external power connection



It is also possible to connect an external antenna demonstration board featuring the energy harvesting function (ANTX-M24LRXXE) to improve or simply evaluate the energy harvesting function using a different antenna.

Figure 6 and *Figure 7* illustrate the use of an external antenna using the ANT1-M24LR16E demonstration board.

- *Figure 6* shows a possible direct connection of the Vout voltage coming from the ANT1-M24LR16E antenna demo board on jumper JP1 to bypass the voltage regulator (U5).
- *Figure 7* shows the connection of the Vout voltage coming from the ANT1-M24LR16E antenna demo board on connector CN2 to use the voltage regulator (U5). Jumper JP1 must be set as shown in *Figure 5*.

Figure 6. External antenna connection with voltage regulator bypass

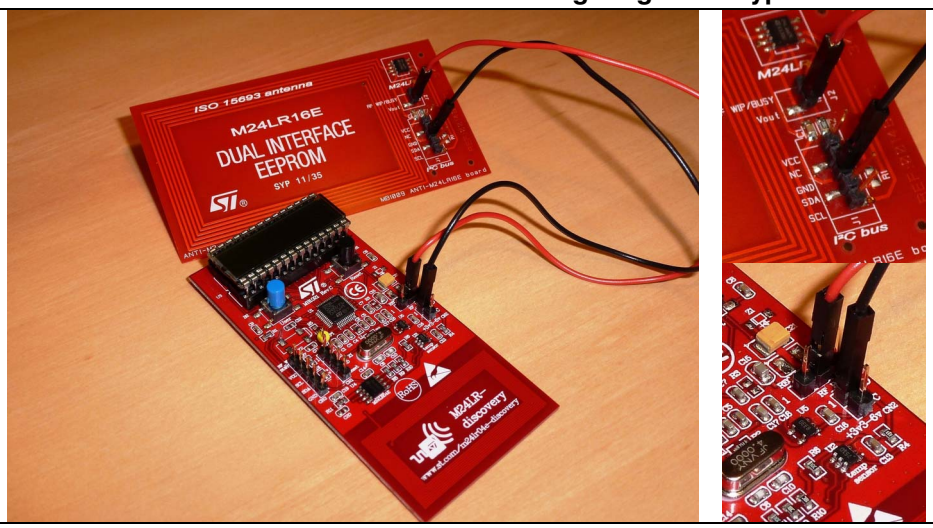
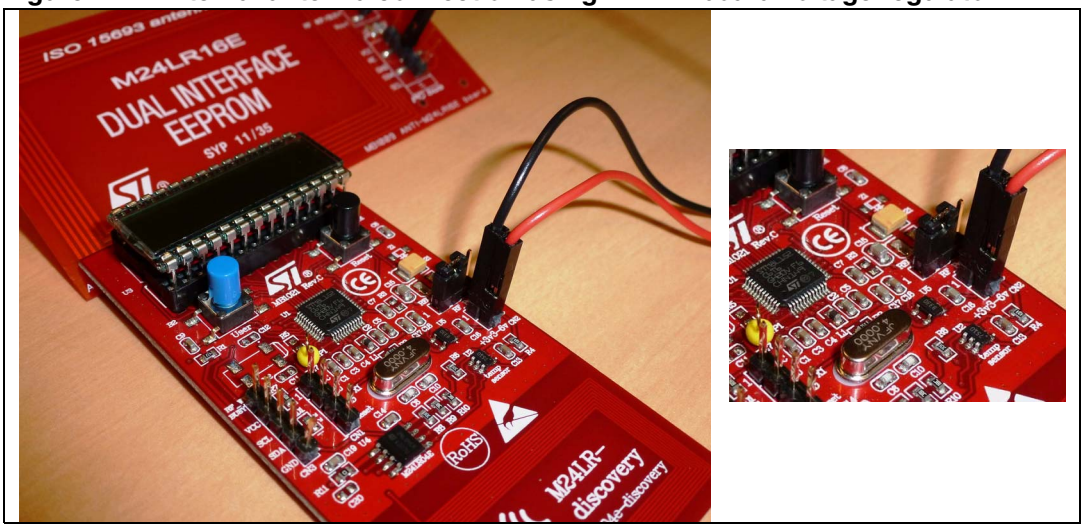
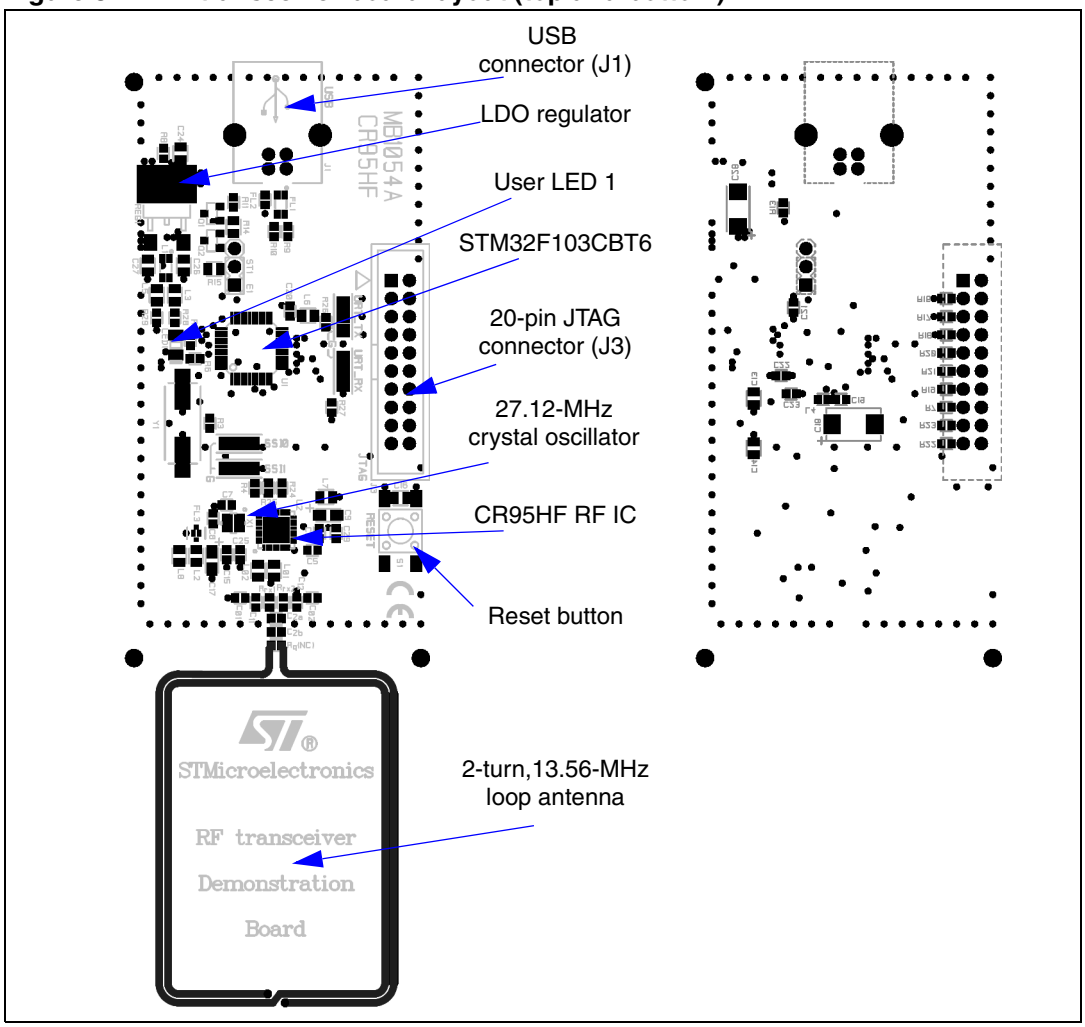


Figure 7. External antenna connection using M24LR board voltage regulator



3.3 RF transceiver board description

Figure 8. RF transceiver board layout (top and bottom)



3.4 RF transceiver demonstration board powering and startup

The RF transceiver demonstration board is powered by the USB bus.

When powered up, the CR95HF starts in an autonomous mode called “tag hunting”: the red LED 1 lights up every time a tag is recognized. During Tag Hunting mode, the RF transceiver demonstration board switches ON and OFF the magnetic field at each RF protocol change. A constant magnetic field is naturally more appropriate to evaluate and develop battery-less applications based on the Energy Harvesting capability of the M24LRXXE-R EEPROM Family.

Tag Hunting mode persists until the M24LR/CR95HF demonstration software is launched and the CR95HF is initialized by the software. At this moment, both Tag Hunting mode and the RF field stop. To activate a constant magnetic field emission, it possible either to open the **Demo NDEF messages** menu and select **Show Demo NDEF & Energy Harvesting** or send a single ISO/IEC15693 RF command (Inventory, Read.).

3.5 Program/debug the M24LR board

To program or debug an STM8L microcontroller application on the M24LR board, simply:

1. Set jumper JP1 in the “REG_3V3” position.
2. Connect an external power supply to the “3V3-6V” connector (CN2).
3. Connect the 4-pin SWIM connector of the STLINK/V2 in-circuit debugger and programmer to connector CN1 as described in *Table 3*.

Table 3. M24LR board programming and debug connector

Pin	CN2	Designation
1	Vcc	VDD supply from M24LR board
2	PA0	SWIM data input/output
3	GND	Ground supply
4	RESET	SWIM reset

3.6 Program/debug the RF transceiver demo board

To program or debug an STM32 microcontroller application on the RF transceiver demonstration board, simply:

1. Connect the 20-pin JTAG/SWD flat ribbon of the STLINK/V2 in-circuit debugger and programmer to the RF transceiver demonstration board JTAG connector (J2).

For more information, documentation about the STLINK/V2 in-circuit debugger and programmer, please visit www.st.com

4 Electrical schematic diagrams

Figure 9. M24LR board schematics

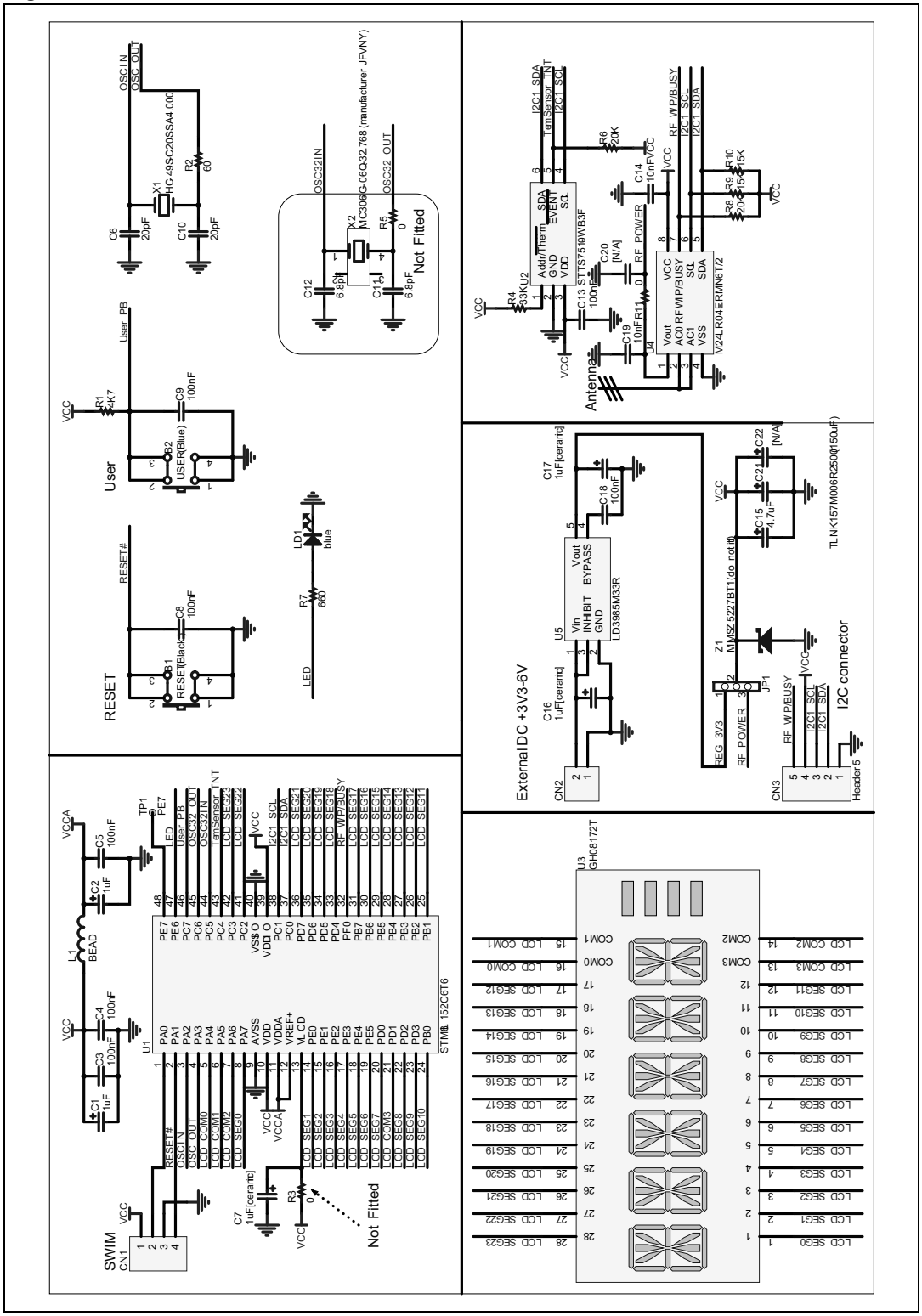


Figure 10. RF transceiver demonstration board schematics (STM32 connections)

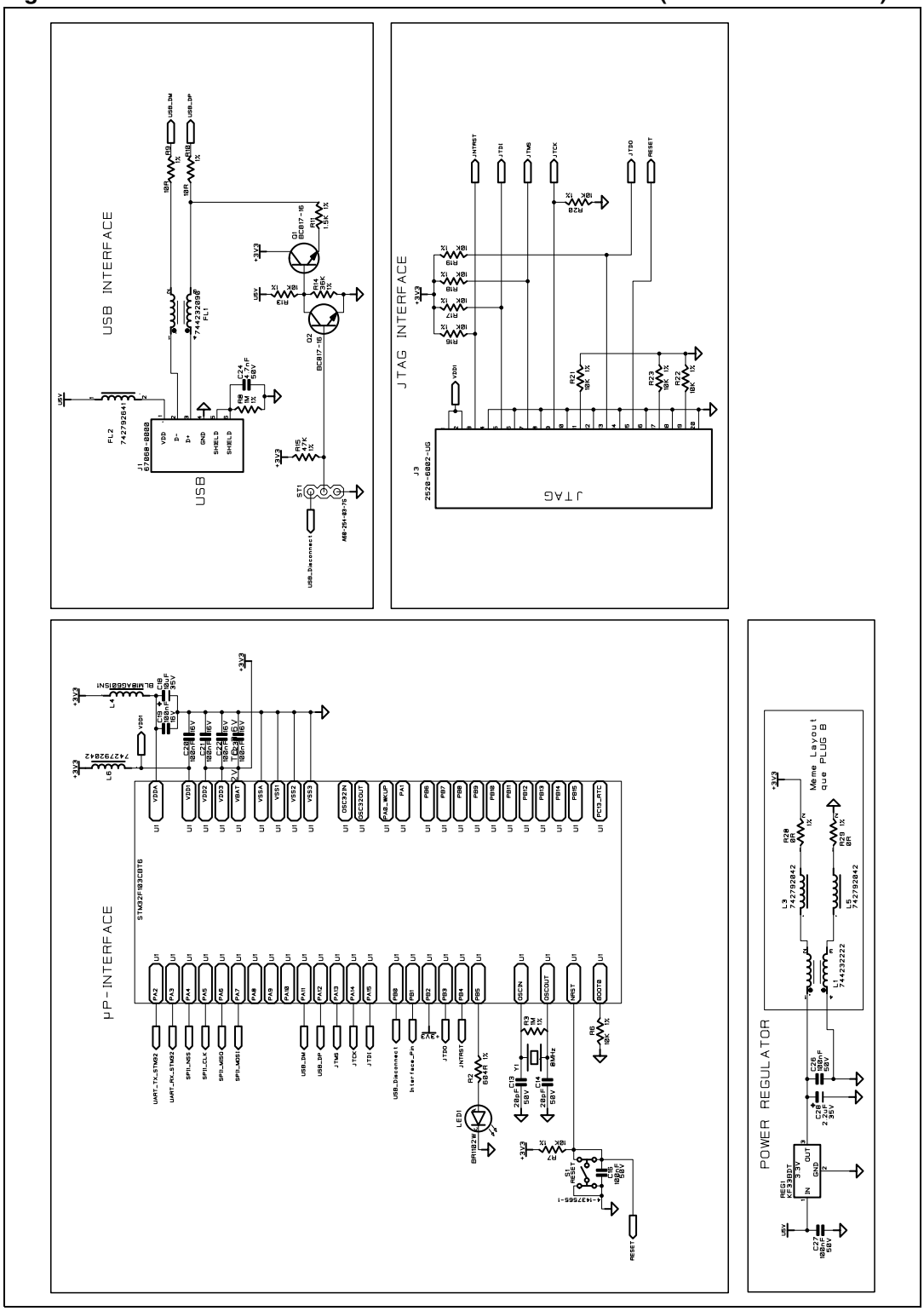
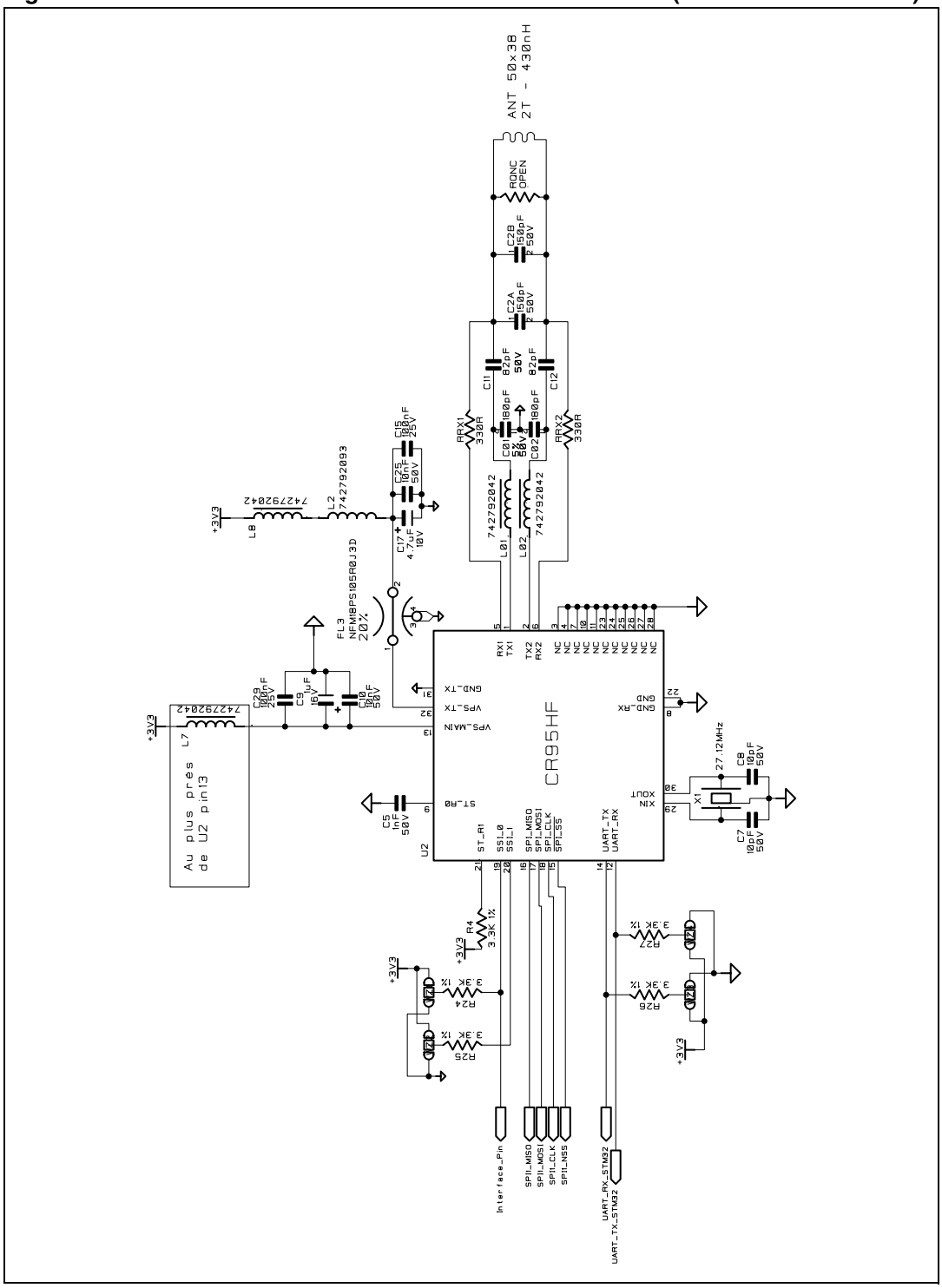


Figure 11. RF transceiver demonstration board schematics (CR95HF connections)



5 Revision history

Table 4. Document revision history

Date	Revision	Changes
06-Nov-2012	1	Initial release.

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