# UM0230
# User manual

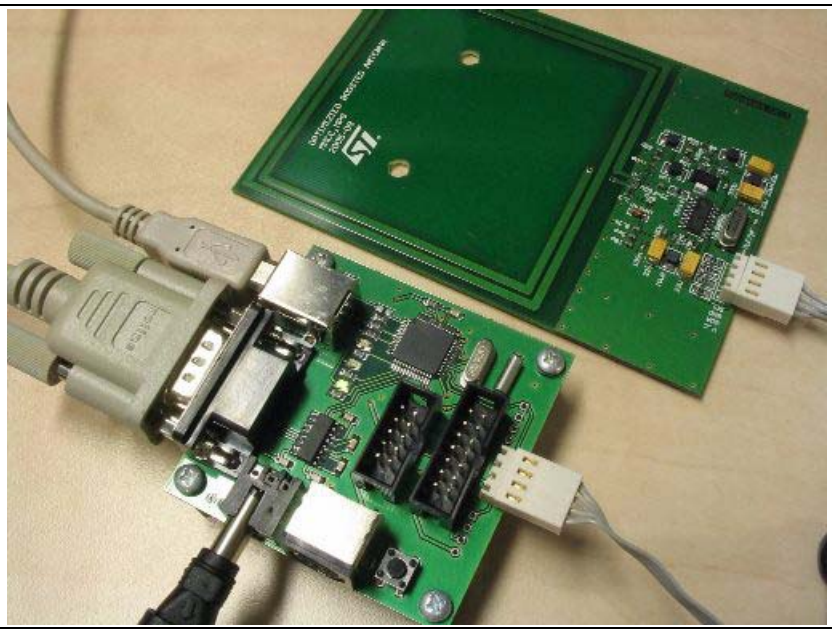
## Short-range RFID reader with autonomous functions

This User manual describes the hardware and software of the demokit for the STMicroelectronics short-range RFID reader with Autonomous functions. The demokit runs under the Windows 98, Windows 2000 and Windows XP operating systems.

The purpose of this demokit is to demonstrate the key features of the STMicroelectronics Short Range RFID family. All products in the family meet global security and cost requirements by complying with the worldwide ISO 14443-B standard and free licensing policy. This particular demokit can be powered in several ways, has a USB and an RS232 interface, and offers PC and autonomous operating modes.

Owing to this diversity and flexibility, it is easier for the customer to further develop the system according to his needs. All the design source data are delivered with the kit, ready to be reused in further developments. The target applications for this demokit are data collection, access control, medical, traceability, brand protection, e-purse and vending machines.

**Figure 1. Demokit hardware for a short-range RFID reader with autonomous functions**



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# 1 Demokit overview

The demokit tools for short-range RFID readers with Autonomous functions are designed to demonstrate several STMicroelectronics products (see *Section 6: References*):
RFID Short Range, Turbo Plus Series and Serial Real-Time Clock products.

## 1.1 RFID Short Range products

These STMicroelectronics products include the CRX14 and CR14 readers, and several contactless memories/tag products: SRI4K, SRIX4K, SRIX512.

All the contactless memories are powered by a transmitted carrier radio wave at 13.56MHz and are compliant with the ISO 14443-B recommendation for the transfer of power and signals via radio transmission. The Short Range CRX14 / CR14 RFID reader circuitry amplitude modulates (10% modulation) the data on the carrier using amplitude shift keying (ASK) and the tag replies by load modulating the data on the carrier using the BPSK (Bit Phase Shift Keying) of a 847kHz subcarrier. The data transfer rate in each direction is 106 Kbit/second.

## 1.2 µPSD3422EV Turbo Plus Series product

The µPSD3422EV belongs to the popular µPSD family of 8051-class embedded Flash microcontrollers that offers system-level-integration with world-leading Flash memory and SRAM densities (up to 256-KBytes and 32-KBytes, respectively) for general-purpose 8-bit embedded applications.

The µPSD3422EV Turbo Plus series performs up to 10 MIPS peak and provides full-speed USB. A JTAG interface supports in-system programming and MCU core debug with high-speed instruction tracing capability, eliminating the need for a hardware In-Circuit Emulator (ICE). Other peripherals include a 16-bit Programmable Counter Array (PCA), an 8-channel, 10-bit resolution analog-to-digital converter, SPI and IrDA interfaces, six PWM (pulse-width modulated) channels, an I²C (Intelligent Interface Controller) master/slave bus controller, two standard UARTs (Universal Asynchronous Receiver/Transmitter), supervisory functions such as a watchdog timer and low-voltage detect, and up to 45 general-purpose I/O pins.

## 1.3 M41T65 (RTC) Serial Real-Time Clock product

The M41T65 (RTC) is used in a broad range of applications. It is available in a lead-free 16-pin QFN package (just 3mm²) and is designed for a bus operating voltage from 3.6V down to 1.3V, but will maintain timekeeping at supply levels as low as 1.0V, thus providing more robust system performance. Operating current is only 350µA on a 3.0V supply, making the RTCs ideal for battery operation and handheld applications. M41T65 operates over the industrial temperature range of –40 to +85° C.

### The kit consists of:

- Circuit boards – Control board with µPSD3422EV and Boosted antenna board
- USB cable
- $I^2C$ cable
- Some transponder samples (of the SRIX4K)
- CD with control software, related user manual, application notes and datasheets.

### Application features:

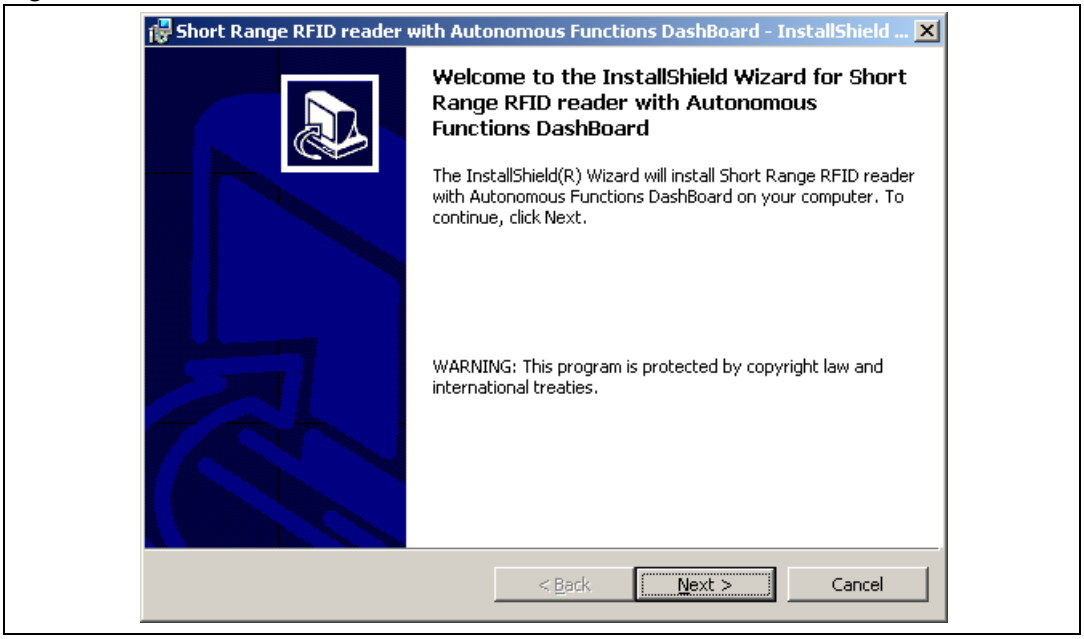
- RAM: 32 Mbit
- HDD free space: 5MB
- USB version 1.1
- Runs on the Windows 98 SE Platform, Windows 2000, Windows XP

# 2 Getting started

## 2.1 Software installation

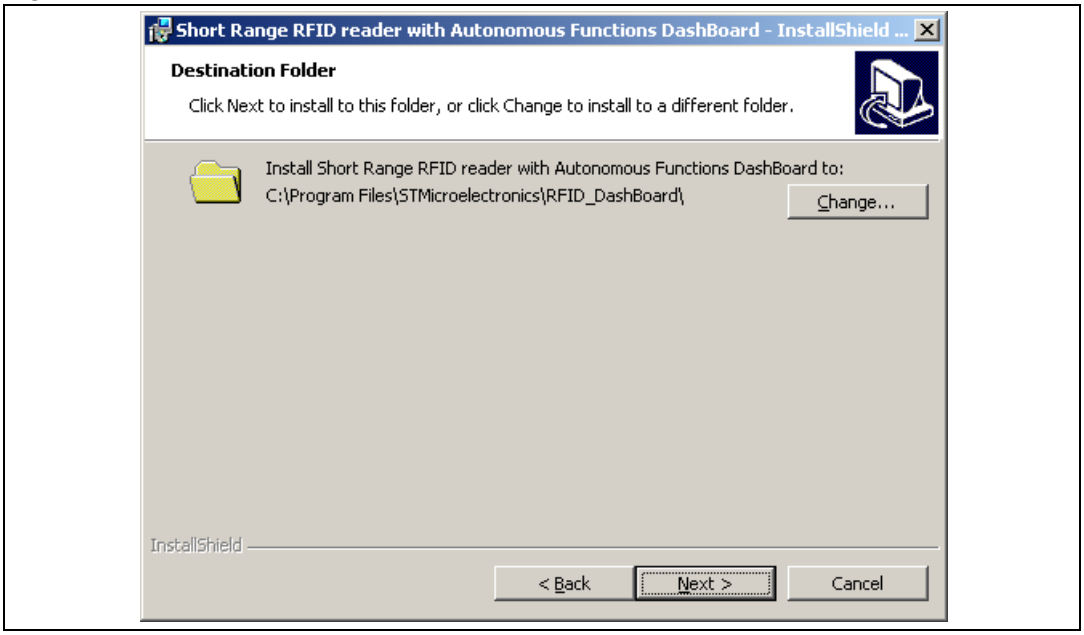
- First insert the CD supplied by STMicroelectronics in your CD drive.
- The auto run will bring up the CD content. Install the Win32 Dashboard software from the Reader software section.
- After opening the folder, run the *setup.exe* program.
- Read the text of the Welcome window (*Figure 2*), and then click on “Next”.

**Figure 2. Welcome window**



- Choose your destination location as shown in *Figure 3*, then click on “Next”. The default folder is C:\Program Files\STMicroelectronics\RFID_DashBoard

**Figure 3. Choose Destination Location window**



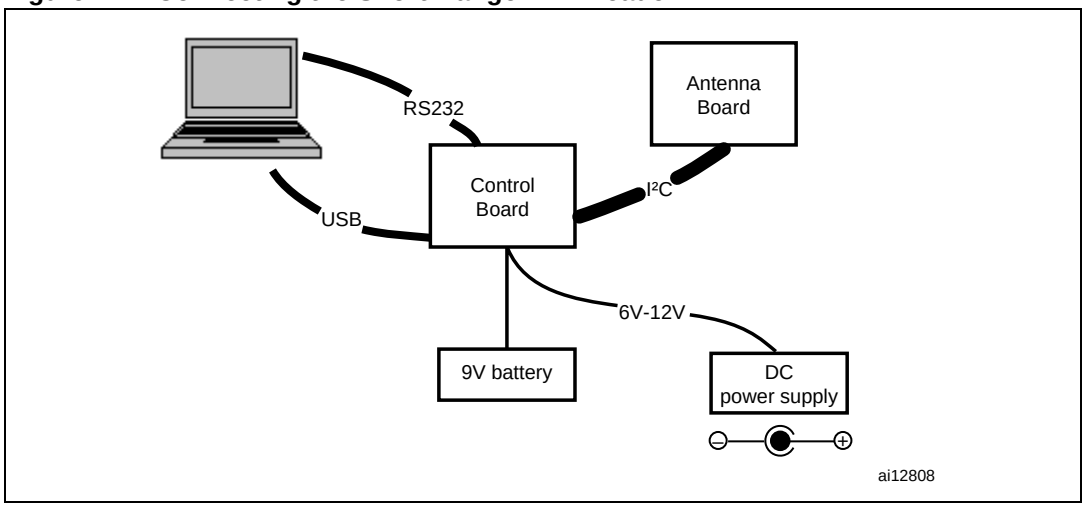
## 2.2 Physical connections

The short-range RFID reader can be connected in different ways as shown in *Figure 4*. To proceed to the connection do as follows:

- Connect the boosted Antenna board to the Control board using the supplied 4-wire ribbon cable.
- Connect the Control board to your PC/Laptop using the supplied USB cable and let Windows recognize the HID class device (no user action needed).
  Optionally you can connect the Control board to your PC/Laptop using the RS232 interface.
- In case you plan to use some of the autonomous functions you can connect a 9V battery or an external DC power supply (6V to 12V).

**Caution:** Disconnect the battery when it is not being used!

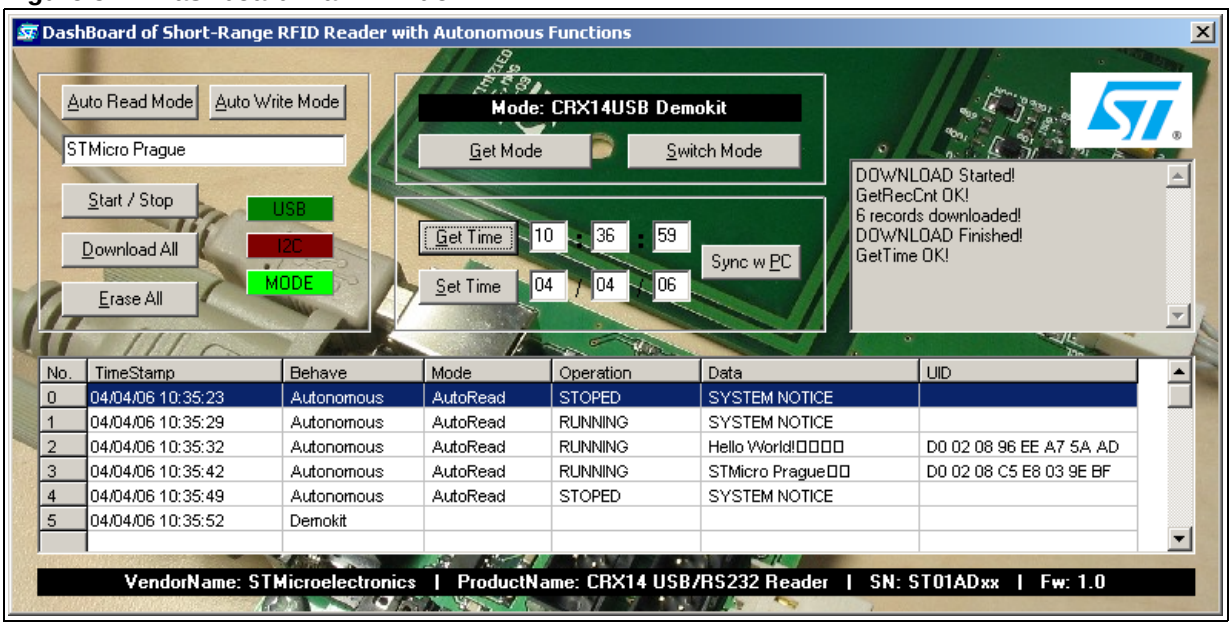
**Figure 4. Connecting the Short-Range RFID reader**



## 2.3 Launching the short-range RFID reader dashboard software

In the *Start* menu, click on *Programs* and select *Reader's Win32 Dashboard* to launch the dashboard software. The Dashboard Main Window shown in *Figure 5* appears.

**Figure 5. Dashboard Main Window**




It is also possible to partially control the demokit via UART. To do so, start Windows HyperTerminal (*Figure 6*) and set up the port settings according to the screenshot shown on the right-hand-side figure (*Figure 7*). The UART communication speed is of 9600kbs, 8 data bits with no parity and 1 stop bit.

**Figure 6. HyperTerminal**

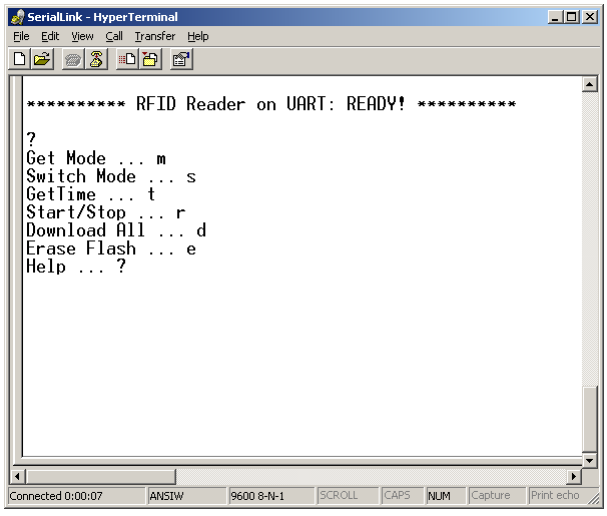
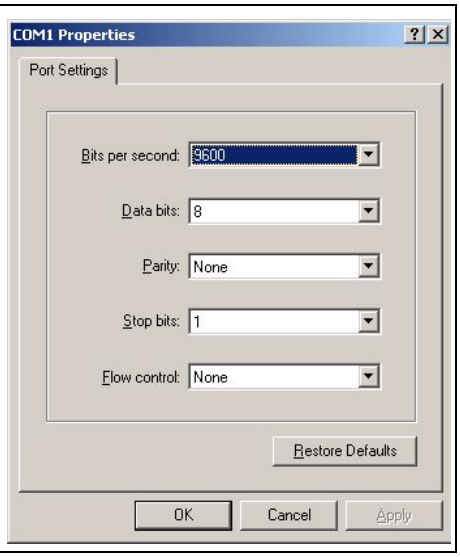



**Figure 7. HyperTerminal settings**



# 3 Short-range reader

The reader has two main modes of operation:

- CRX14USB Demokit Mode
- Autonomous Mode

In the CRX14USB Demokit Mode, the reader behaves exactly in the same way as in the CRX14USB Demokit (see the UM0080 User manual) and is fully compatible with the CRX14Demokit software.

In the Autonomous Mode, the PC can send a macro-command to the reader via the USB or the RS232 cable, and the reader can then execute it without any further need of the PC.

There are two Autonomous Mode sub-functions: **AutoRead** and **AutoWrite**.

- **In the AutoRead cycle:** after a “Start” (from either the push button or the PC), the onboard reader reads the UID of whatever tag (STMicroelectronics Short Range family) comes into the antenna field, and deals with the ASCII User Data (either read (AutoRead) or write operations (AutoWrite)). Every event is logged as a record in the Flash memory of the µPSD.
- **In the AutoWrite cycle:** first the reader has to memorize the user phrase, then, after a “Start” (from the push button or the PC), the reader always writes the same ASCII phrase to the User Data area of whatever tag (STMicroelectronics Short Range family) that comes into the antenna field. The rest of the User Data is filled with blanks.

Successful read and write operations are indicated by the flashing of Green LED 1. The cycles have to be ended by a “Stop” (from either the push button or the PC). The only case where a cycle will end automatically is when the Flash memory space is full (full FLASH detected). Once the operation is stopped, the stored data can be downloaded to the PC through a USB or UART macro-command. If the Autonomous reader cycle is stopped the whole Flash memory record storage space can be erased via another macro-command.

Switching between the CRX14USB Demokit Mode and the Autonomous Mode can be done either through a software command from the PC or by pressing and holding the onboard button (SW1) for a few seconds.

## 3.1 Memory records

Autonomous Events are all being stored in the Flash memory space of the onboard microcontroller. To minimize and simplify Flash memory management, a simple principle of incremental write of records with fixed length (32 Bytes) is used. The structure of an event record is described in *Table 1*.

**Table 1. Event record structure**

| Name | Offset [Bytes] | Length [Bytes] | Description |
|---|---|---|---|
| Header | 0 | 1 | Header of the record |
| Status Byte | 1 | 1 | Status byte of the reader |
| Data Field | 2 | 16 | Storage of the User Data received in Auto Read Mode |
| UID | 18 | 8 | Unique identifier of the tag that triggered Autonomous Event |
| Date Time | 26 | 6 | Time Stamp of the Autonomous Event |

**Table 2. Status Byte**

| Name | Bit order | Description |
|---|---|---|
| Reader Mode | 0 | Autonomous / CRX14 Demokit mode (0 / 1) |
| Autonomous Cycle | 1 | Run / Stop (0 / 1) |
| Autonomous Status | 2 | AutoWrite / AutoRead (0 / 1) |
| Record Type | 3 | State change notice / Data Record (0 / 1) |
| System Notice | 4 | Power lost / Default (0 / 1) |
| RFU | 5-7 | Reserved |

## 3.2 Control board description

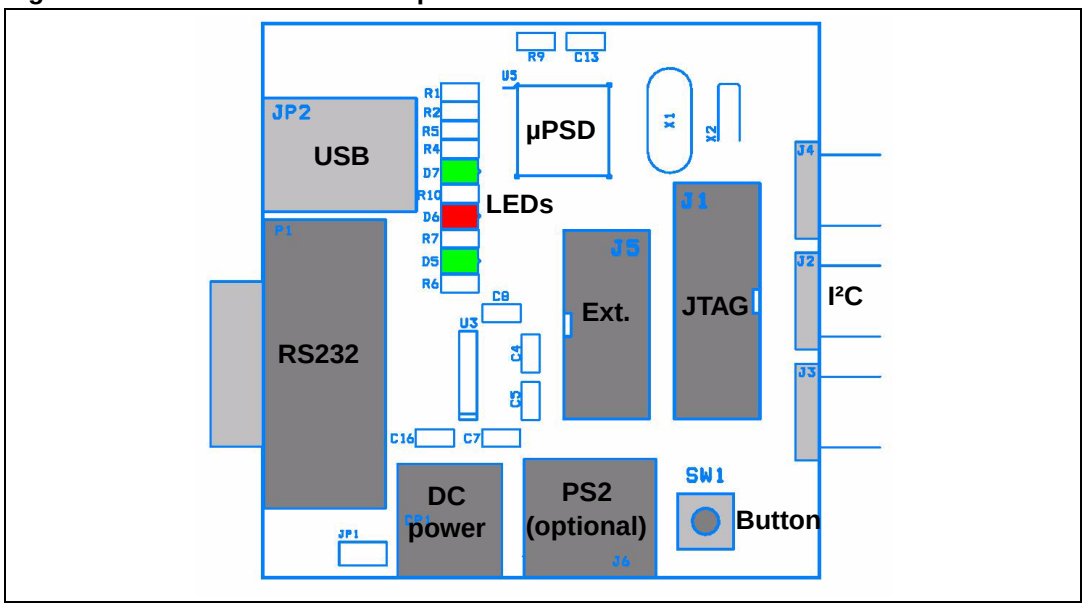
To use the Control board in Autonomous mode it is useful to get familiar with the onboard diagnostic LEDs:

- Green LED 1 (the green LED closer to the µPSD chip) lights up to indicate an activity on the interface to the higher system, that is on the USB or RS232 ports.
- The red LED shows communication activity on the I²C bus and can therefore be interpreted simply as RF activity.
- Green LED 2 informs about the operating status of the board. It will light up in a continuous way in the CXR14USB Demokit mode and flash in the Autonomous mode.

**Table 3. Onboard LED description**

| Onboard LED | Description |
|---|---|
| Green LED 1 | Activity on PC interfaces (USB / RS232) |
| Red LED | Activity on $I^2C$ interface (delegated to RF activity) |
| Green LED 2 | Reader's mode of operation<br>Continuous / Flashing = CRX14USB Demokit mode / Autonomous mode |

**Figure 8. Control board description**




1. Ext. means Extension header. The extension header is optional.

# 4 Win32 Dashboard Control

The dashboard of the short-range RFID reader is divided into five panels: “Mode Switch”, “Mode Control”, “RTC Control”, “Memory Records” and “Runtime Log”. They are shown in *Figure 9*.

In the “Mode Switch” panel, located at the center of the window, the user can switch modes (*Switch Mode* button) or check (*Get Mode* button) the current operating mode of the reader.

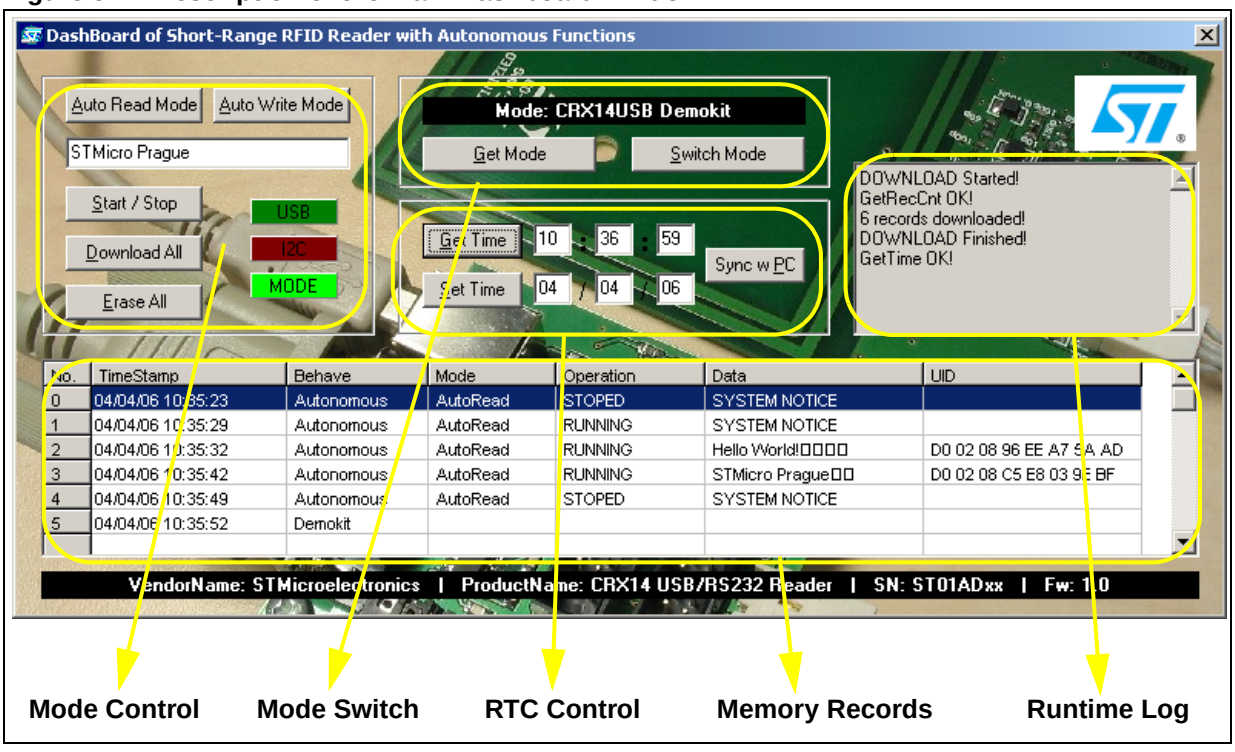
The “Mode Control” panel, on the left-hand side of the window, contains controls for Autonomous cycle setup and supervision: *Auto Read Mode* button, *Auto Write Mode* button, AutoWrite Mode Phrase edit box and *Start / Stop* button.
The panel also accommodates the *Download All* and *Erase All* buttons used for the maintenance of the Event Records stored in the onboard memory.
The three software LEDs that mirror the real-time behavior of the reader are also on the “Mode Control” panel.

The “RTC Control” panel, located below the “Mode Switch” panel, contains the controls related to the reader’s Real Time Clock (RTC) chip: *Set Time* and *Get Time* buttons.
By pressing the *Sync w PC* button the user can easily synchronize the onboard reader’s time with the local PC/Laptop time.

The “Memory Records” panel, located at the bottom of the window, stores the information received from the reader after the *Download All* button has been pressed.

The “Runtime Log” panel, on the right-hand side of the window, simply traces all the activity managed by the Win32 Dashboard.

**Figure 9. Description of the main Dashboard window**



# 5 HyperTerminal Control

The short-range reader can also be operated using an RS232 terminal software. A basic list of the commands used for that purpose is provided in *Table 4*. The response to these commands is usually formatted as a human readable string to be easily displayed on a win32 terminal.

**Table 4. RS232 interface commands**

| Name | Command | Response/Description |
|---|---|---|
| Get Mode | ‘m’ | Current Status Byte (Hexadecimal) |
| Switch Mode | ‘s’ | Status Byte after the change (Hexadecimal) |
| Get Time | ‘t’ | Board time from RTC |
| Start/Stop | ‘r’ | Status Byte after the change (Hexadecimal) |
| Download All | ‘d’ | Memory record dump |
| Erase Flash | ‘e’ | Confirmation of operation |
| Help | ‘?’ | List of available commands |

# Appendix A Schematic diagrams

**Figure 10. Control board schematics**

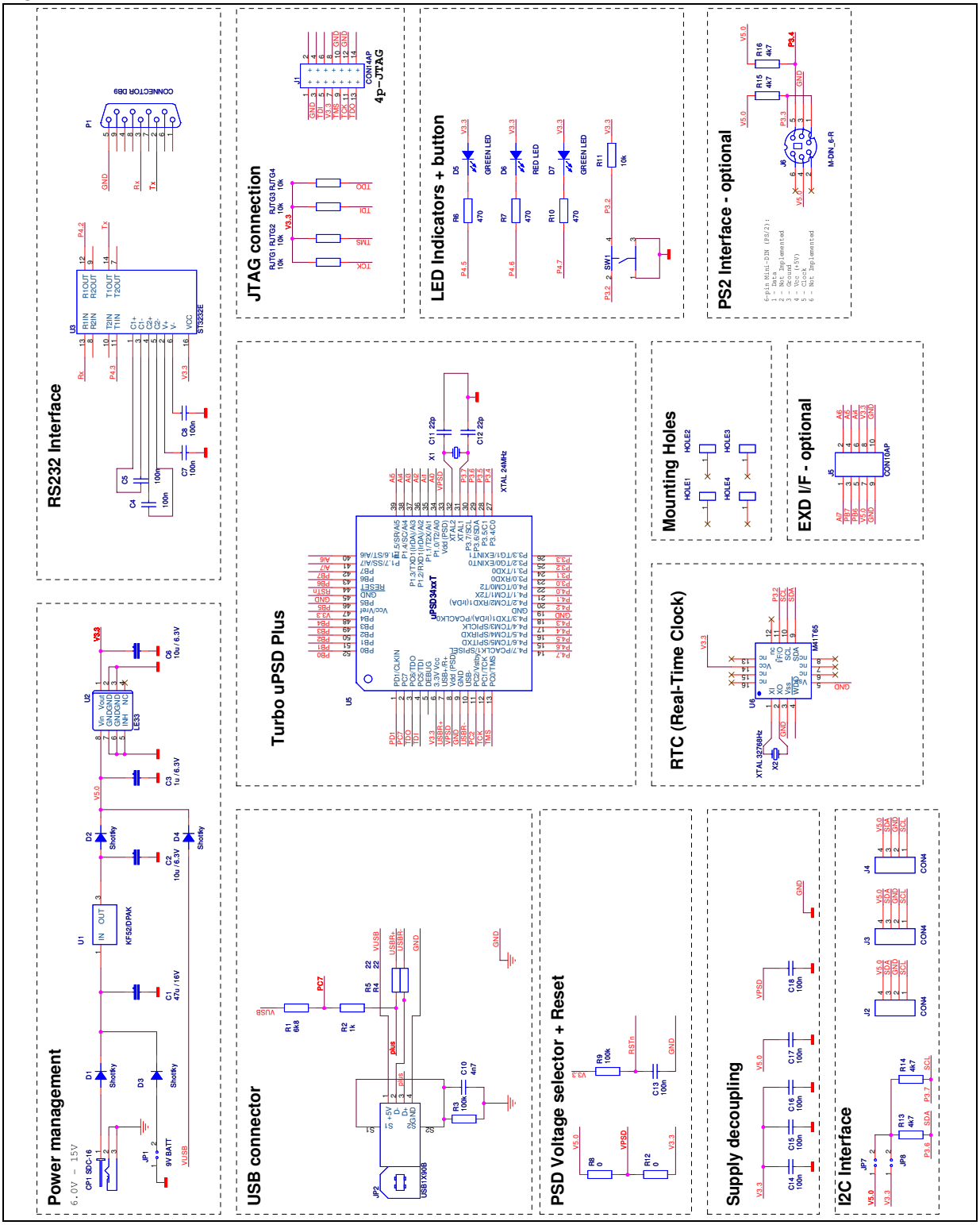
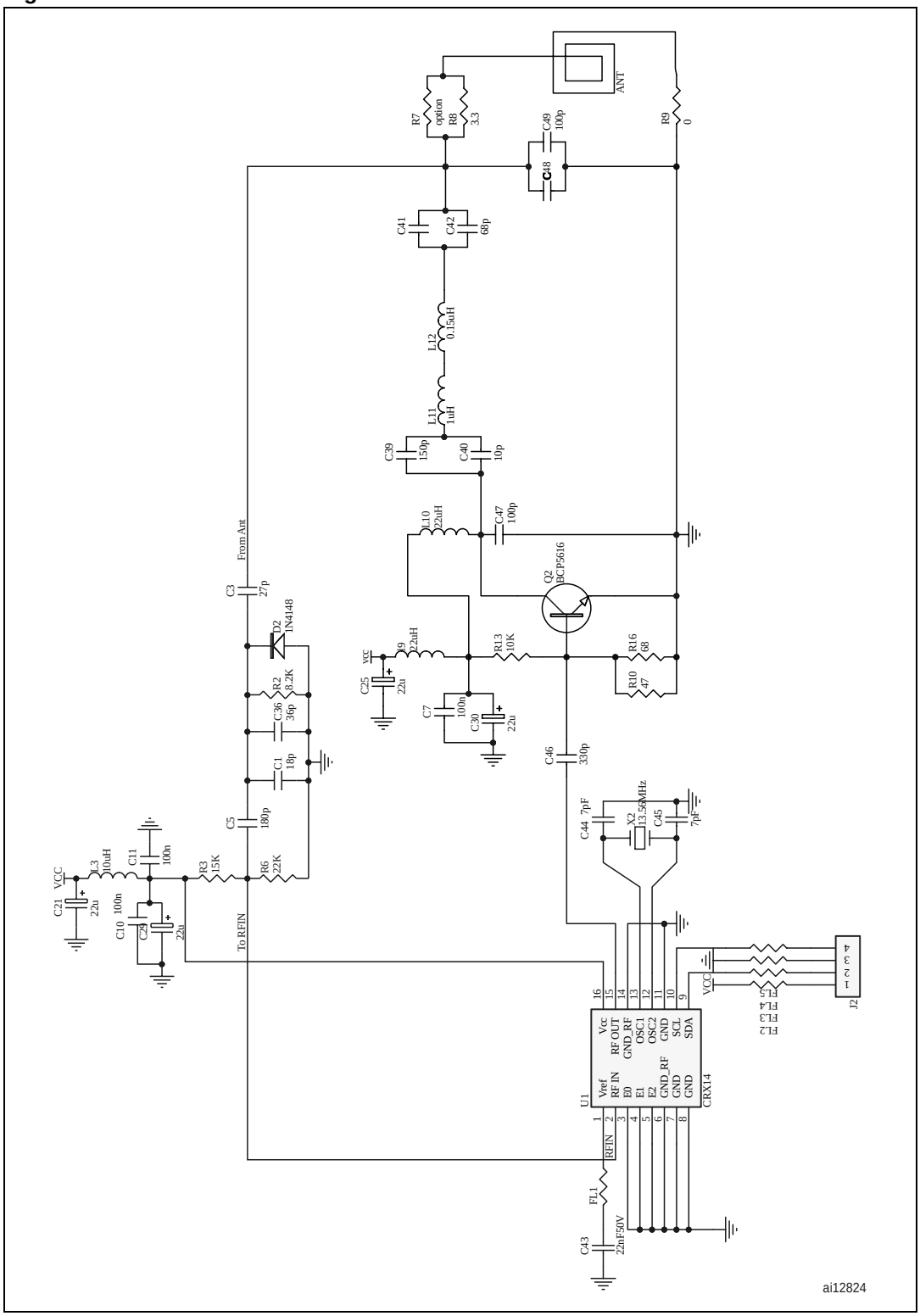


**Figure 11. Antenna board schematics**



# 6 References

- User manual UM0080: “Reader USB CRX14 (V4.0) Demonstration Software”.
- CR14 datasheet: “Low Cost ISO14443 type-B Contactless Coupler Chip with Anti-Collision and CRC Management”
- CRX14 datasheet: “Low Cost ISO14443 type-B Contactless Coupler Chip with Anti-Collision, CRC Management and Anti-Clone Function”
- µPSD3422EV datasheet: “Turbo Plus Series, Fast Turbo 8032 MCU with USB and Programmable Logic”
- M41T65 datasheet: “Serial Access Real-Time Clock with Alarms”

# 7 Revision history

**Table 5. Document revision history**

| Date | Revision | Changes |
|---|---|---|
| 14-Apr-2006 | 1 | Initial release. |

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