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RFicient®
ULTRA-LOW POWER WAKE-UP RECEIVER

APPLICATION NOTE AP002

Getting started with WakeUpEvalSuite

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Introduction

WakeUpEvalSuite is a compilation of tools and methods implemented in a graphical user interface. This simplifies the interaction with RFicient® WakeUp Receiver. This application note describes functions and functionality of the WakeUpEvalSuite and shows by means of several examples a possible evaluation procedure with RFicient® WakeUpEvalSuite and WakeUp Receiver.

1 Getting Started

1.1 Graphical User Interface

The interface between the user and the hardware makes it easy to configure the hardware without having any in-depth knowledge of it. The graphical user interface, hereafter referred to as GUI, can be used with several evaluation and development kits for RFicient® WakeUp Receiver. All types of RFicient® WakeUp evaluation hardware will be referred to as HwEvalKit hereafter. Each type of HwEvalKit has its own GUI implementation, named SwEvalKit in this document.

1.1.1 Main Window

The main window of the WakeUpEvalSuite, shown in Figure 1, provides information about RFicient® WakeUp hardware connected to the computer.
The surrounding area “1” in Figure 1 contains symbols of detected HwEvalKits. A mouse click on a symbol starts the SwEvalKit implementation corresponding to the detected HwEvalKit unit. Area “2” in Figure 1 provides more detailed information about the connected HwEvalKits. The arrow button marked as “3” performs an update of the connected HwEvalKits with a mouse click. This is useful when connecting or disconnecting new HwEvalKits during program execution.

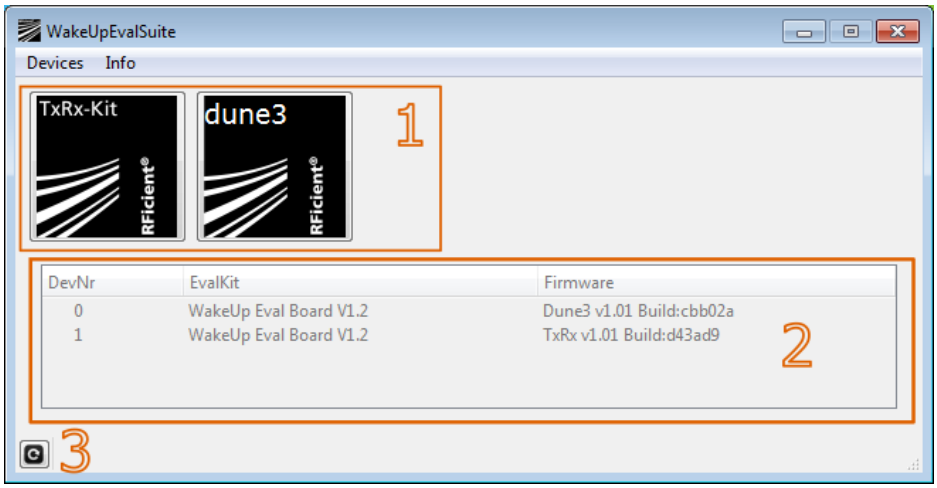

Figure 1: WakeUpEvalSuite Main Window

1.1.2 TxRx-Kit GUI

The main feature of TxRx-Kit GUI shown in Figure 2 is the generation and wireless transmission of a user-defined data pattern encoded in the RFicient® WakeUp receiver format. The encoding of a WakeUp telegram defines both a logical “1” as well as “0” represented by a different code sequence, called “codeA” and “codeB” respectively and mandates a preamble sequence at the start of the telegram. The raw data stream of the WakeUp telegram generated from the user-defined data pattern (payload) is displayed in the TX Raw Data mask. The datarate of both the preamble and the payload can be defined separately according to the requirements of the application. [1]

Examples:

Use case 1: generate only a WakeUp-pattern

Setting the payload data rate to “disabled” deactivates the generation of a data pattern and the raw TX data contains only a preamble sequence (codeA). This can be used to send a single WakeUp pattern with a configurable data-rate.

Use case 2: sending a WakeUp-Telegram containing a data payload:

Setting the payload data rate to a fixed value will add the defined payload to the generated WakeUp telegram. This payload can be used as an identifier to selectively address a specific WakeUp node.

The displayed features in the GUI depend on the connected HwEvalKit.

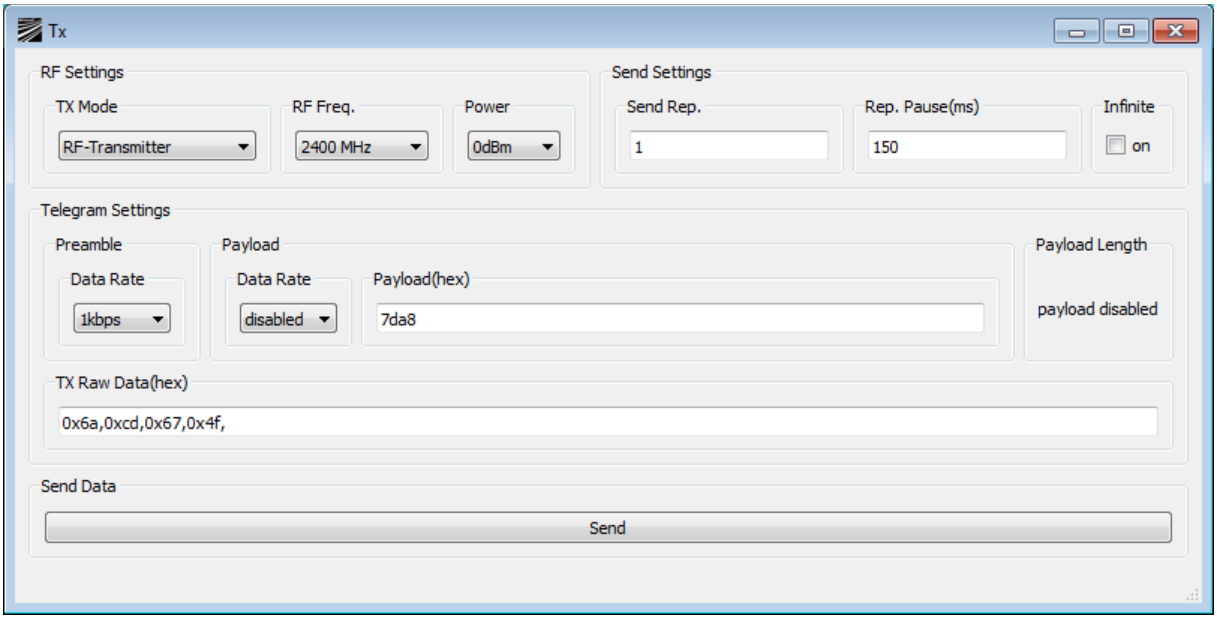

Figure 2: TxRx-Kit GUI

[1] Please refer to the data sheet for details on how the configured datarates affect the sampling scheme of the WakeUp receiver.

1.1.3 RFicient® Dune3EvalKit GUI

The Dune3EvalKit GUI shown in Figure 3 provides functionality that allow the user to set and manage the register settings and access the key features of the RFicient® WakeUp receiver.

The most important settings such as the RF frequency, data rate and interrupt definitions can be conveniently set using the GUI. The calculation and generation of the calculated register values based on the user input is done in background.

Setting the RF frequency is achieved by entering the required frequency [MHz] into the Rx Frequency input field on the GUI as an integer value. The input value of both the RX frequency as well as the data rates of preamble and payload must correspond to the defined frequency as well as the data rates of the sender. Depending on the requirements, the payload and the associated interrupts can be switched on.

The RX tab shown in Figure 4 allows the evaluation of the data reception quality and shows additional data which is useful for range measurements. This provides the basic statistics for an evaluation of the WakeUp error ratio. The Signal Quality A/B is a percentage value related to the maximum correlator code length 31 and the correlator value of the last received codeA/B. The event shows which interrupt has triggered.
The interrupt event value bit assignment is:
(codeA/B<<3)+(FiFoLength<<2)+(FiFoOverflow<<1)+(ID<<0).

Note: The clear button deletes the statistic and the existing telegrams in the telegram field and does not stop the reception of the data.
Note: In order to restore the functionality after a register reset, it is necessary to activate the SwEvalKit symbol in the WakeUpEvalSuite main window again. This performs the necessary on-chip calibrations and adjusts the frequency automatically.

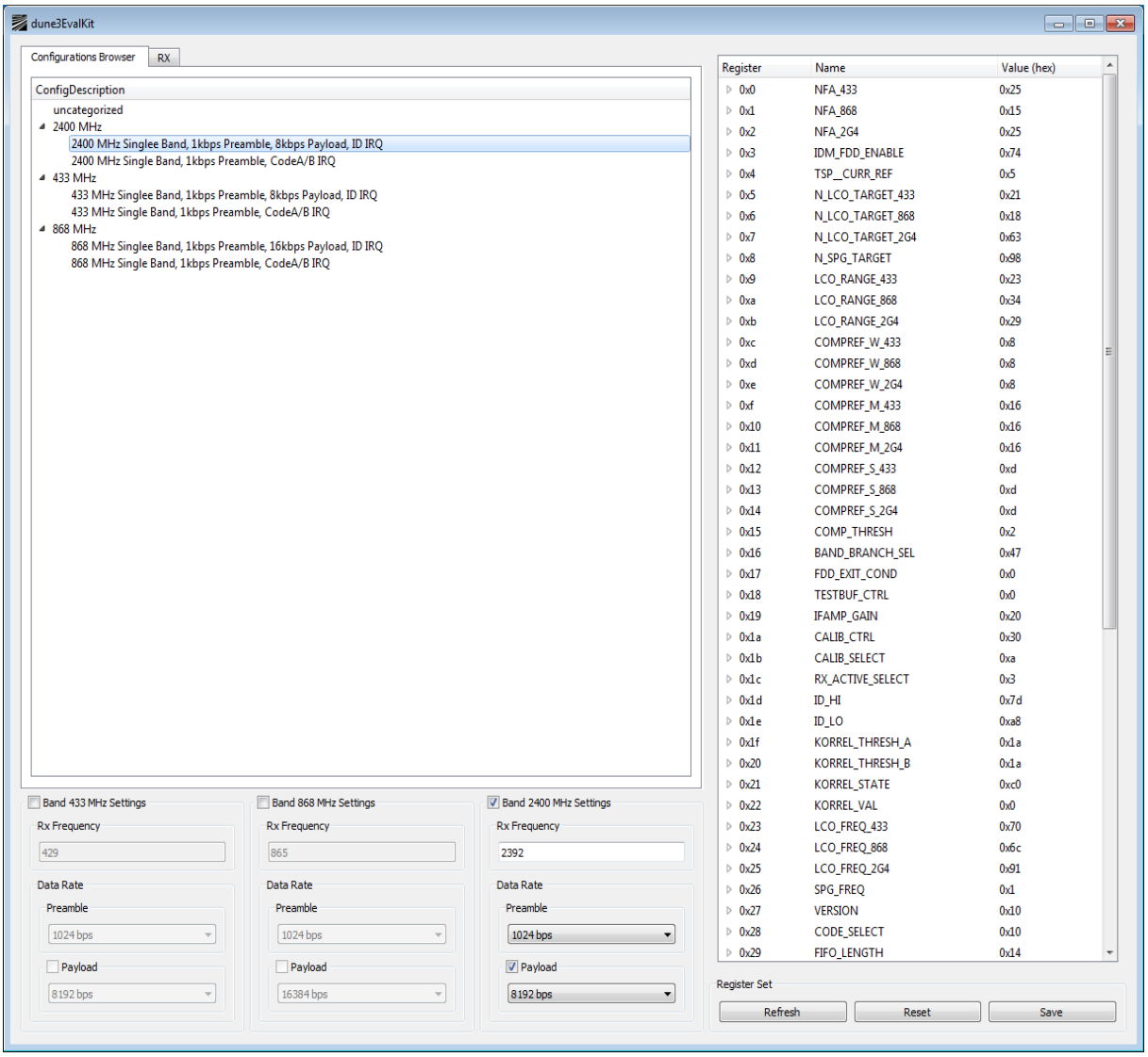

Figure 3: Dune3EvalKit GUI

Direct access to the register is provided through the register mask in the right half of the GUI. The register values can be changed by entering a value or by opening and setting or deleting the individual bits.

Note: Directly changing the register values here requires in-depth knowledge of the data sheet.

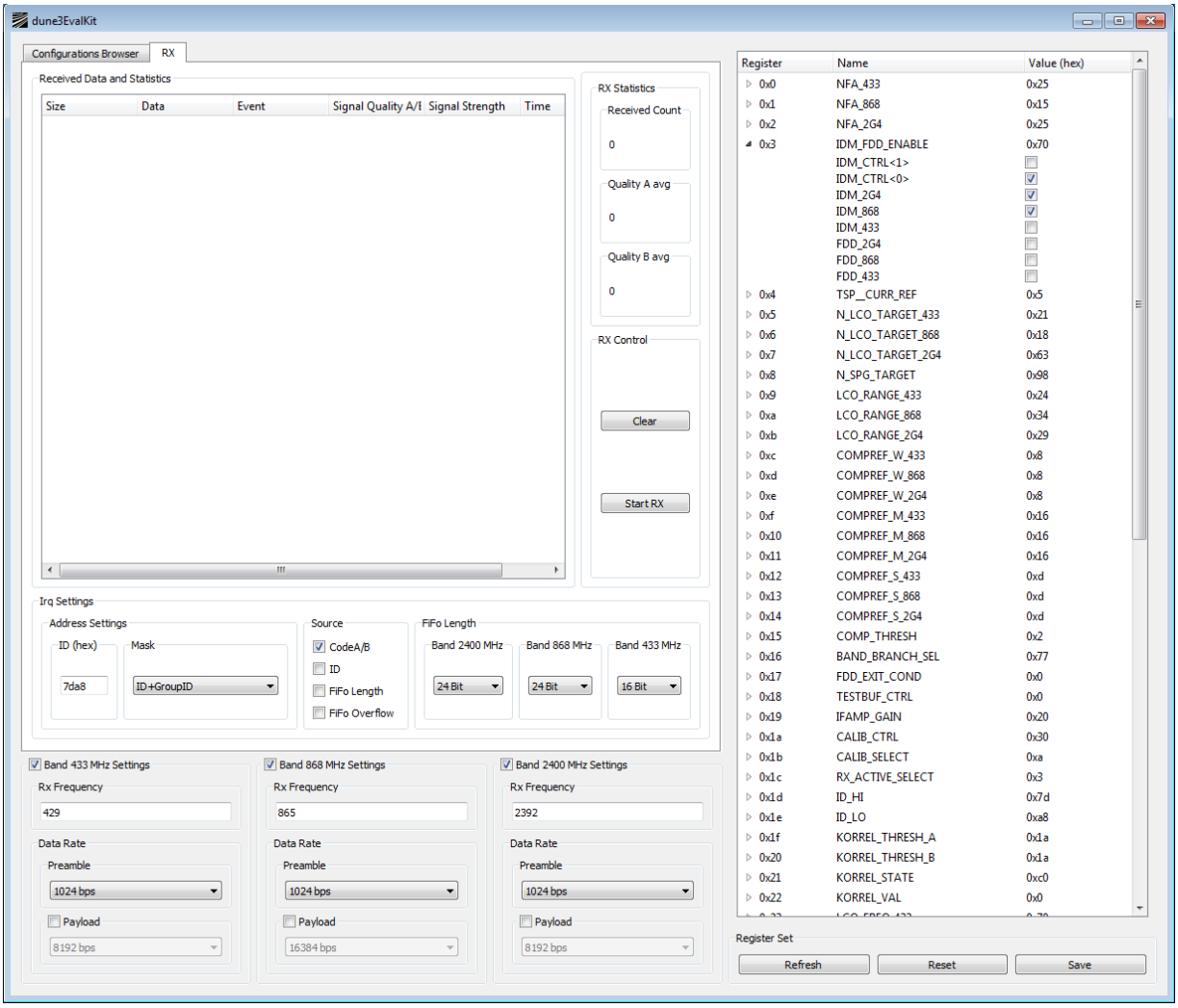

Figure 4: Dune3EvalKit RX Tab

2 Distance Measurement and Evaluating with WakeUpEvalSuite

With any radio receiver, the question arises how well can I receive the data in a certain radio environment or if any data is lost. The ratio between data received and sent is called bit error ratio (BER=received/sent). In the case of the RFiecient® WakeUp receiver, data is encoded in bit-error tolerant codeA or codeB sequences, and thus not the erroneous bits but the erroneous code sequences are relevant.

This ratio is referred to as WakeUpER.

This section shows two possible ways to determine the WakeUpER of the RFiecient® WakeUp receiver with the WakeUpEvalSuite. The first measurement is done with a sent preamble only, which is especially useful in heavily disturbed wireless environments.

The second measurement is based on addressing the RFiecient® WakeUp receiver such that every WakeUp receiver node can be woken up individually.

The measurements shown here refer to the 2400 MHz frequency band. The procedure is the same for the other bands.

2.1 Preparations

It must be ensured that the hardware kits are ready, that the necessary USB drivers are installed and that the hardware is connected to the computer. A transmitter and a RFicient® WakeUp hardware kit are required for the measurement.

Figure 1 shows kits attached to the computer, connected are a Transmitter-kit (TxRx-Kit) and a RFiecient® WakeUp receiver (IC code name Dune3) kit. The sender and receiver should be set up at a distance of about one meter from each other. This distance can be increased later.

2.2 Distance Measurement: WakeUpER with preamble

The goal of this measurement is to send 10 preamble telegrams and receive them with the RFiecient® WakeUp receiver.

Settings of the transmission side are:

Tx Mode (RF-Transmitter)
RF Freq. (2400 MHz)
Power (0dBm)
Send Rep. (10)
Rep. Pause (150 ms)
Infinite(not set)
Preamble(Data Rate(1kbps))
Payload(Data Rate(disabled))

If the above settings are chosen correctly, the result is a telegram TX RAW DATA(0x6a,0xcd,0x67,0x4f). If this is not the case, recheck the Tx settings.

For setting up the receiver side, the following steps are necessary: find a predefined configuration “2400 MHz Single Band, 1kbps,Preamble, CodeA/B IRQ” under “Configuration Browser” category 2400 MHz. Double mouse click or context menu load the config. The resulting receiver settings after this step are shown in Figure 5.

Next, the tab RX is selected (as shown in Figure 4). Push the “Start RX” button to start querying for data packets.
Next, push the “Send” button on the Tx GUI. Now the data field of the RX tab should be filled with code telegrams as shown in Figure 5.

That’s it! Increase the distance between TX and RX boards and repeat the measurement. In order to obtain enough data a for reliable statistical analysis, the Tx GUI value Send Rep. can be increased as needed.

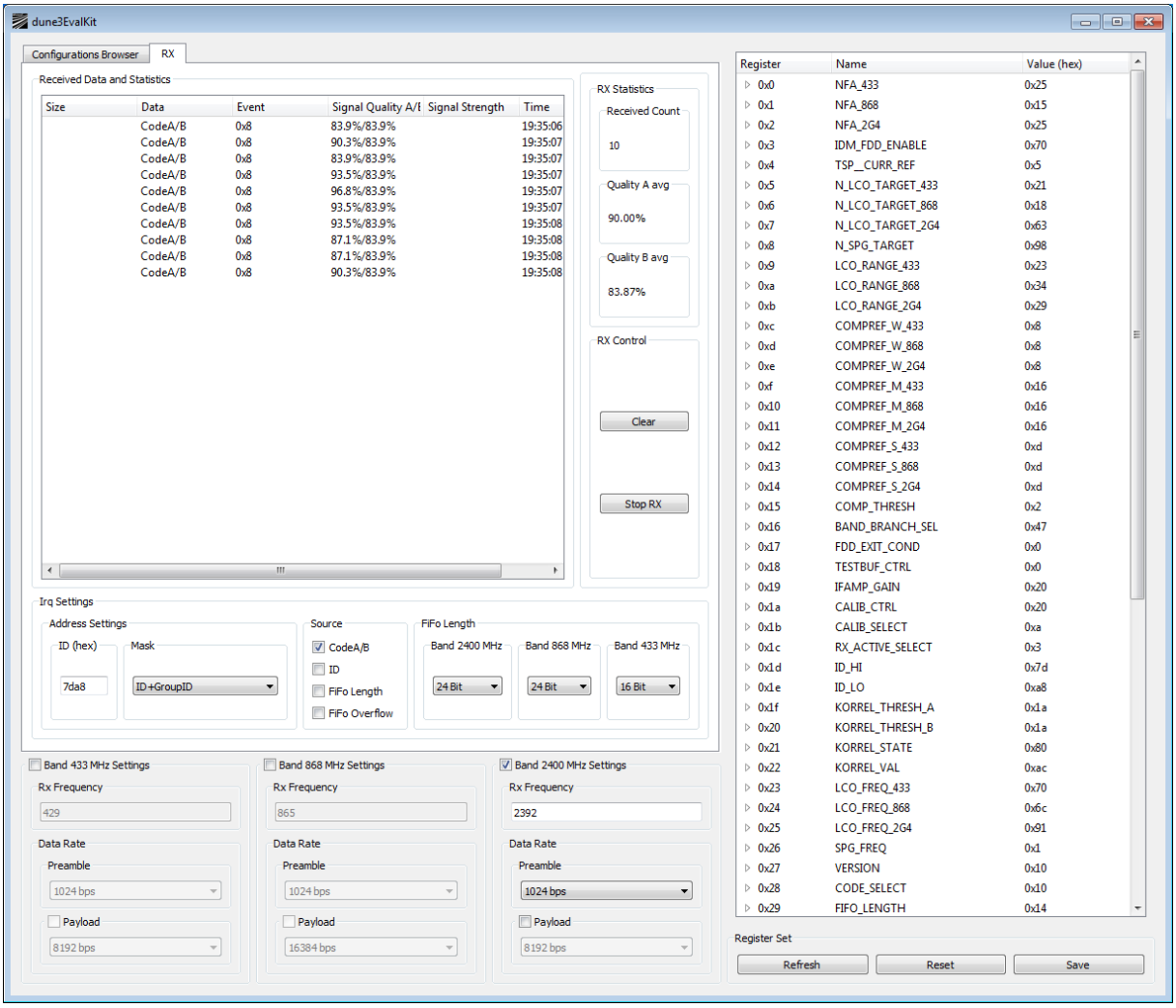

Figure 5: dune3EvalKit RX Tab CodeA/B

2.3 Distance Measurement: WakeUpER with payload, addressed

The goal of this measurement is to send 10 addressed telegrams and receive them with the RFiecient® WakeUp receiver with the unique ID 0x7da8.

Note: the first 2 bytes of the payload are used as the WakeUp receiver address (ID).

The settings of the transmission side are:

Tx Mode(RF-Transmitter)
RF Freq.(2400 MHz)
Power(0dBm)
Send Rep.(10)
Rep. Pause(150 ms)
Infinite(not set)
Preamble(Data Rate(1kbps))
Payload(Data Rate(8kbps))
Payload(Payload(7da8))

If the above settings are chosen correctly, the result is a telegram TX RAW DATA(0x0,0xff,0xff,0x0,0xff,0x0,0xff,0x0,0xff,0xff,0x0,0x0,0xff,0xff,0x0,0xff,0x0,0xff,0xff,0x0,0x0,0xff, 0xff,0xff,0x0,0xff,0x0,0x0,0xff,0xff,0xff,0xff,0x0,0x0,0x0,0x6a,0xcd,0x67,0x4f,
0x6d,0x38,0x97,0x73,
0x6d,0x38,0x97,0x73,
0x6d,0x38,0x97,0x73,
0x6d,0x38,0x97,0x73,
0x6d,0x38,0x97,0x73,
0x6a,0xcd,0x67,0x4f,
0x6d,0x38,0x97,0x73,
0x6d,0x38,0x97,0x73,
0x6a,0xcd,0x67,0x4f,
0x6d,0x38,0x97,0x73,
0x6a,0xcd,0x67,0x4f,
0x6d,0x38,0x97,0x73,
0x6a,0xcd,0x67,0x4f,
0x6a,0xcd,0x67,0x4f,
0x6a,0xcd,0x67,0x4f,)

If this is not the case, recheck the Tx settings.
For setting up the receiver side, the following steps are necessary: find a predefined configuration “2400 MHz Single Band, 1kbps,Preamble,8kbps Payload ID IRQ” under “Configuration Browser” category 2400 MHz. Double mouse click or context menu load the config. The resulting receiver settings after this step are shown in Figure 6.

Next, the tab RX is selected. RX tab is shown in Figure 4. Push the Start RX button to start the receive. After that push the Send button on the Tx GUI. Now the data field of the RX tab should be filled with code telegrams shown in Figure 6.

That's it! Increase the distance between TX and RX boards and repeat the measurement. In order to obtain enough data a for reliable statistical analysis, the Tx GUI value Send Rep. can be increased as needed.

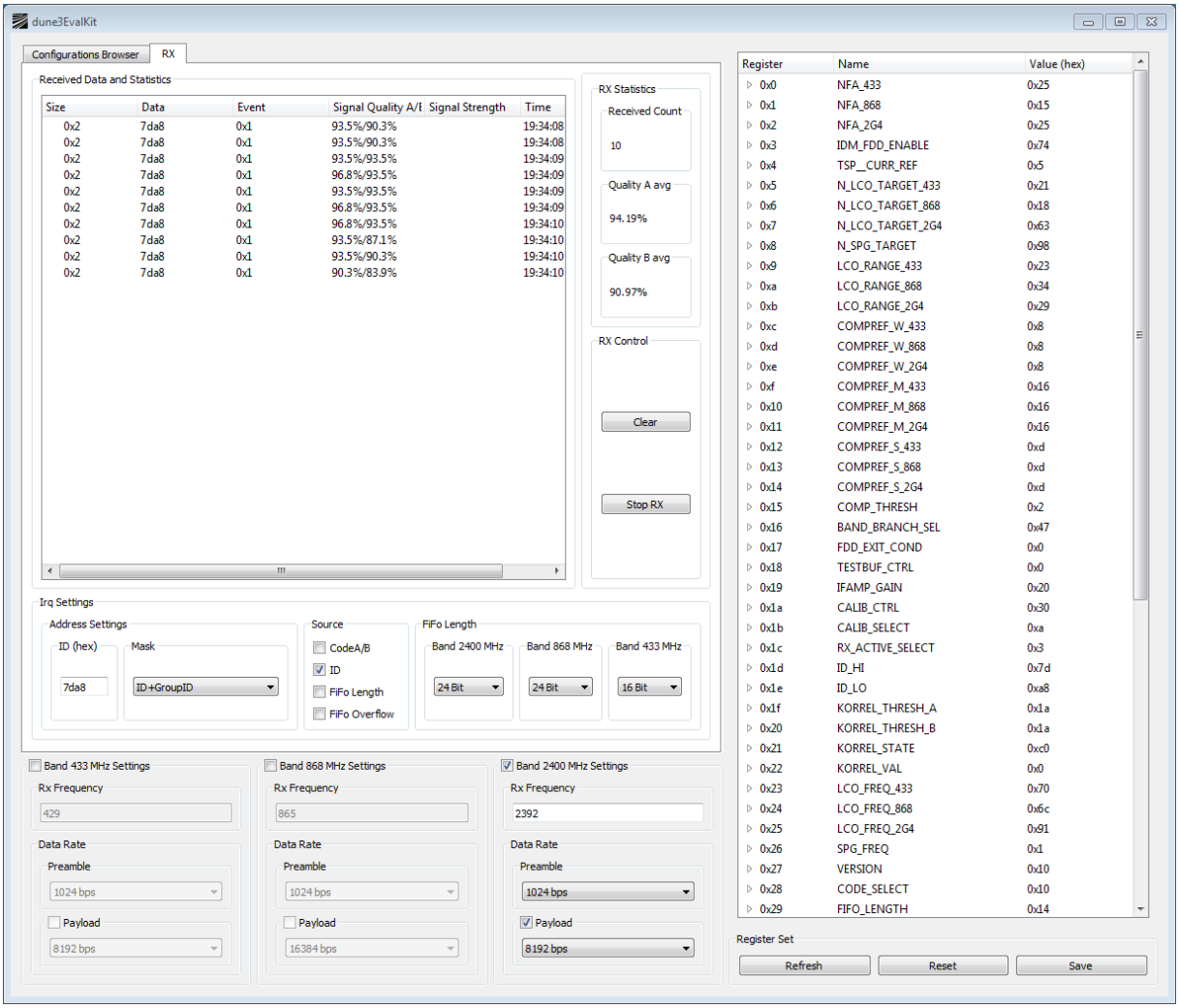

Figure 6: dune3EvalKit RX Tab IDM

3 System Requirements

Operating System:	Windows 7 (64bit) or higher Linux 64bit, MacOS >=10.12.6
Driver:	FTDI D2XX www.ftdichip.com
Interfaces:	>=USB1.1