

Using the S2-LP GUI

AMG RF Application team

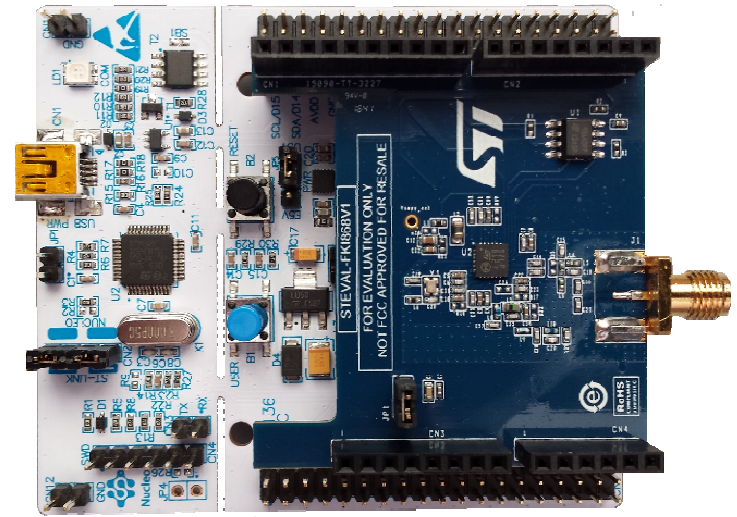
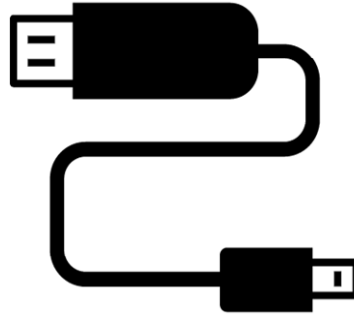


What do we need?

2



A PC running
Windows 7, 8, 10

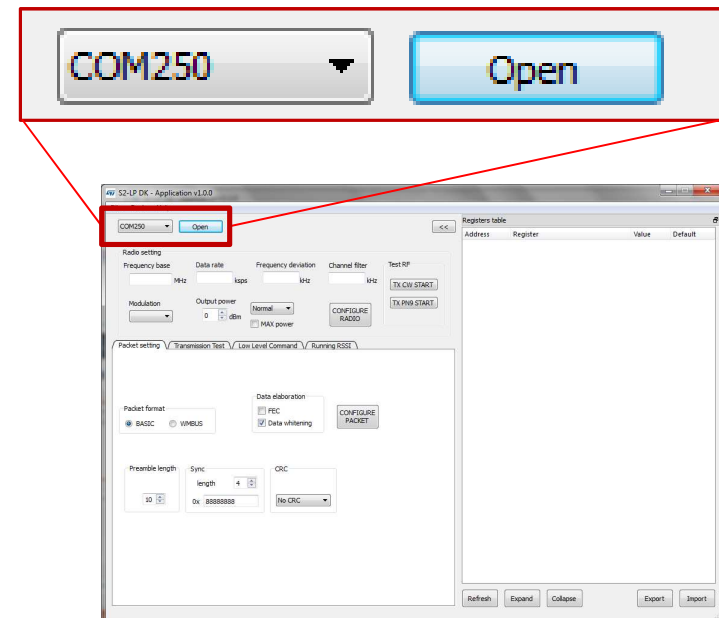


A *STEVAL-FKIxxxV1* with
the *S2-LP CLI* firmware

Open the COM port

3

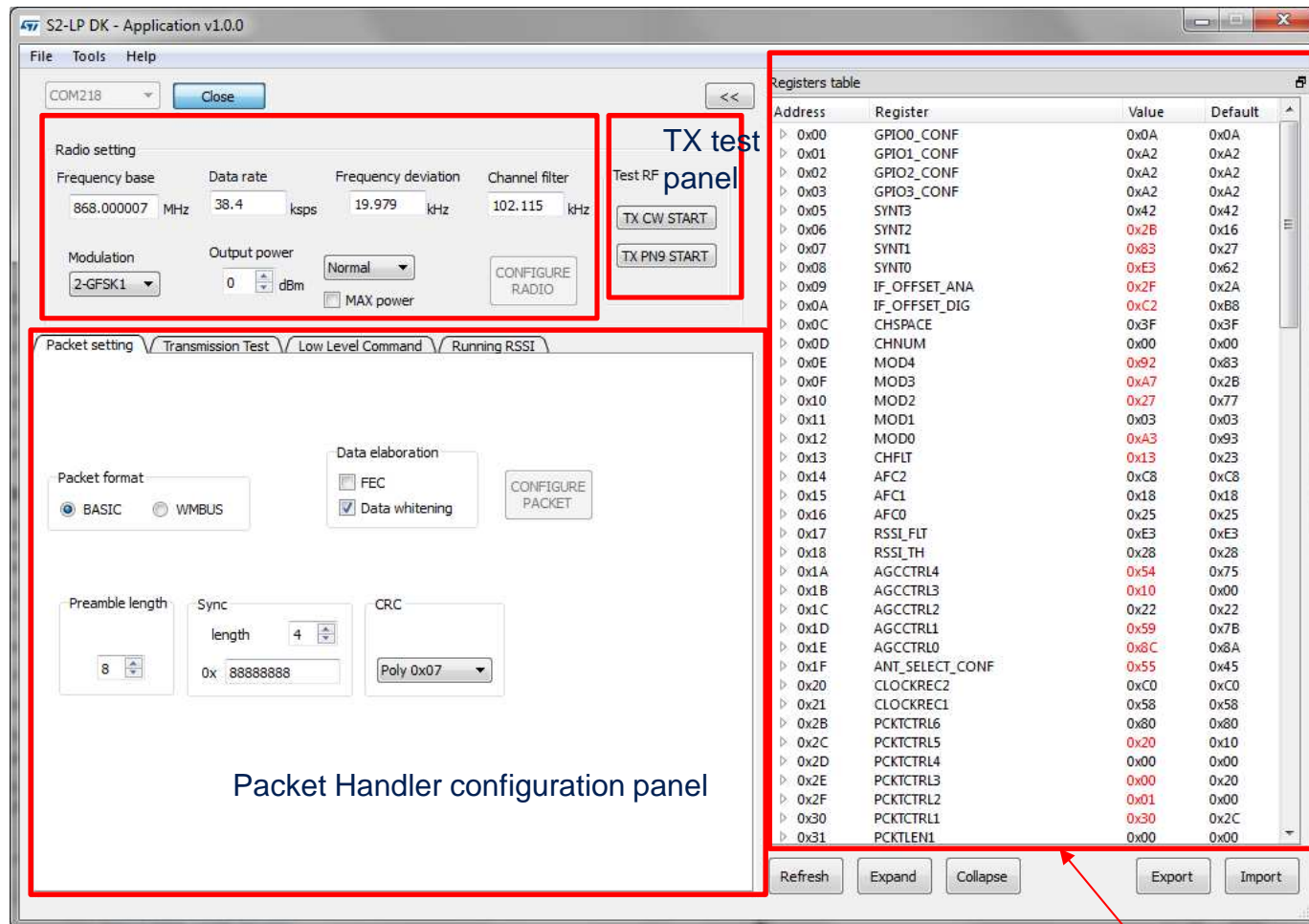
- If the STM32 NUCLEO PC driver is correctly installed on the PC, the board will be enumerated.
- The COM port assigned to the board will be shown on the COM port combo box.
- Clicking on open, the GUI will do some preliminary checks:
 1. ask the firmware version
 2. Compare with the minimal version required
 3. If it does not respond to the version it will ask the user to proceed with an automatic FW update



Functionalities of the S2-LP GUI

4

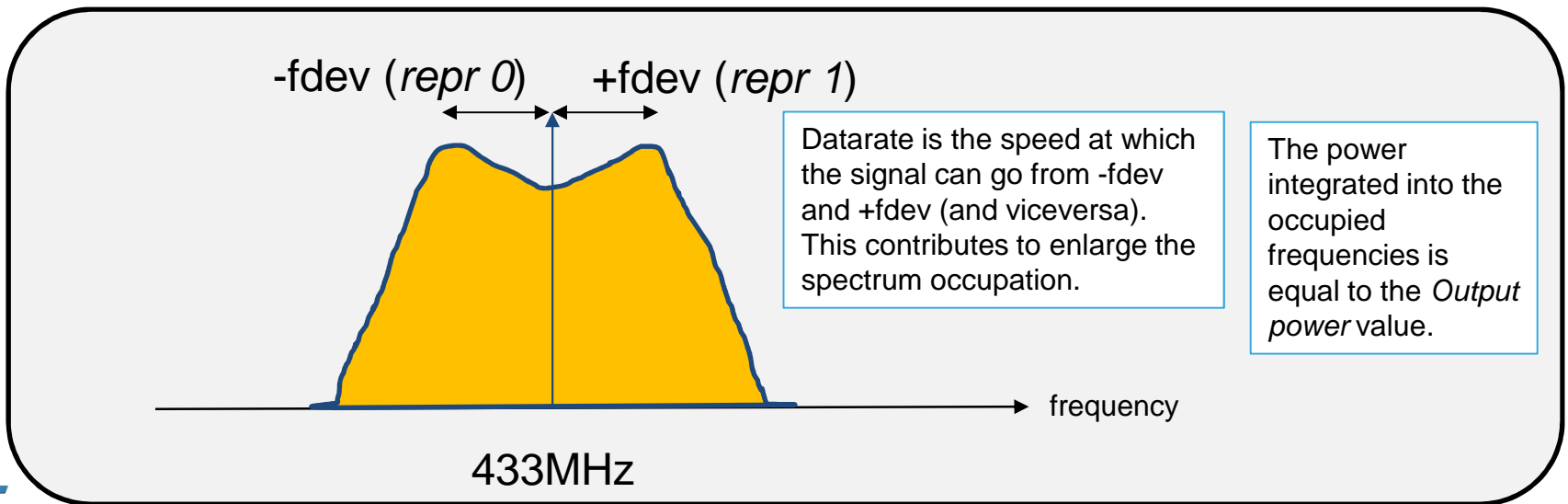
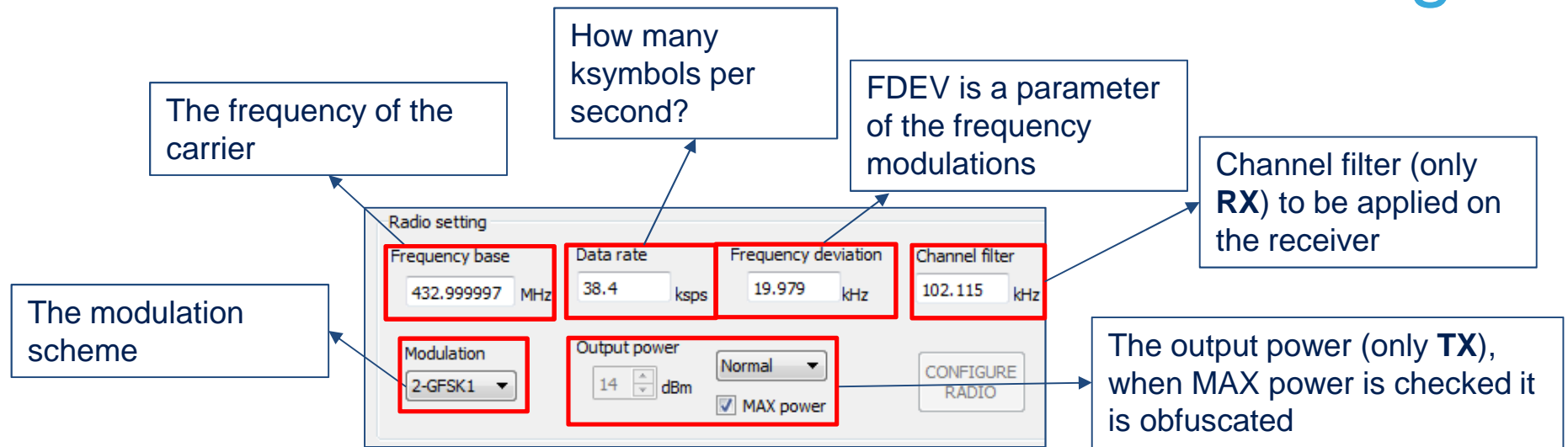
Radio configuration panel



Registers panel

Radio setting

5

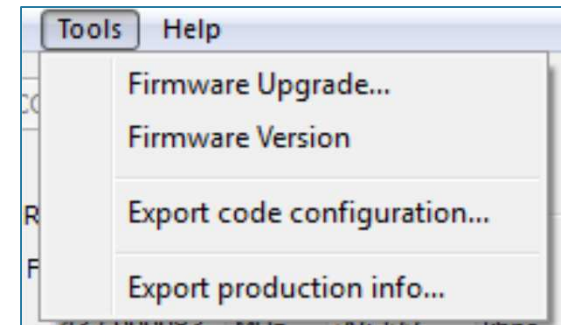


- **Firmware Upgrade...**

- Flash the firmware on the motherboard. This function makes use of the embedded ST-Link of the Nucleo board.

- **Firmware Version**

- Read the firmware version.



- **Export code configuration...**

- This option generates a C-language list of instructions that write on the S2-LP registers the values that are different from the default values to quickly configure the device.

- **Export production info...**

- Saves a text file containing the manufacturing info of the board.

7

- The intent is to allow the user to select his own configuration easily and then see or save the register values that are needed in order to keep the same configuration on his firmware.
- For this purpose, this feature can be used in cooperation with the "Export code configuration" tool.



Table of registers

8

Registers table

Address	Register	Value	Default
0x00	GPIO0_CONF	0x0A	0x0A
0x01	GPIO1_CONF	0xA2	0xA2
0x02	GPIO2_CONF	0xA2	0xA2
0x03	GPIO3_CONF	0xA2	0xA2
0x05	SYNT3	0x52	0x42
0x06	SYNT2	0x3A	0x16
0x0E	MOD4	0x32	0x83
0x0F	MOD3	0xA7	0x2B
0x10	MOD2	0x27	0x77
0x11	MOD1	0x03	0x03
0x12	MOD0	0xA3	0x93
0x13	CHFLT	0x13	0x23
0x14	AFC2	0xC8	0xC8
0x15	AFC1	0x18	0x18
0x16	AFC0	0x25	0x25
0x17	RSSI_FLT	0xE3	0xE3
0x18	RSSI_TH	0x28	0x28
0x1A	AGCCTRL4	0x54	0x75
0x1B	AGCCTRL3	0x10	0x00
0x1C	AGCCTRL2	0x22	0x22
0x1D	AGCCTRL1	0x59	0x7B
0x1E	AGCCTRL0	0x8C	0x8A
0x1F	ANT_SELECT_CONF	0x55	0x45
0x20	CLOCKREC2	0xC0	0xC0
0x21	CLOCKREC1	0x58	0x58
0x2B	PCKTCTRL6	0x80	0x80
0x2C	PCKTCTRL5	0x20	0x10
0x2D	PCKTCTRL4	0x00	0x00
0x2E	PCKTCTRL3	0x00	0x20
0x2F	PCKTCTRL2	0x01	0x00
0x30	PCKTCTRL1	0x30	0x2C
0x31	PCKTLEN1	0x00	0x00

Details of register MOD3 (0x0F)

Bits	Field	Description
7:0	DATARATE_M(7:0)	The LSB of the mantissa value of the data rate equation, default 38.4 kbps. $\text{Data_Rate} = \text{fDig} / 2^{32} * \text{DATARATE_M}, \text{ if DATARATE_E}=0$ $\text{Data_Rate} = \text{fDig} / 2^{33} * (2^{16} + \text{DATARATE_M}) * 2^{\text{DATARATE_E}}, \text{ if DATARATE_E} > 0$ $\text{Data_Rate} = \text{fDig} / (8 * \text{DATARATE_M}), \text{ if DATARATE_E}=15 \text{ (jitter free mode)}$ For the value of fDig, please look at the description of XO_RCO_CONFIG1 register (address 0x6C).

Buttons: Refresh, Expand, Collapse, **Export** (1), **Import** (2)

- It is possible to change the registers setting by clicking on a specific register (Value column) and writing the new value. When a register has changed, its value is highlighted in red. It is not possible to write the reserved fields

- Double clicking on a register, a detailed description of its fields is provided.

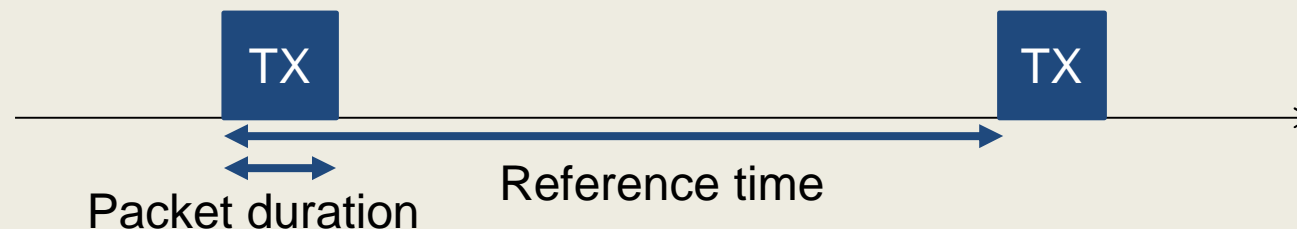
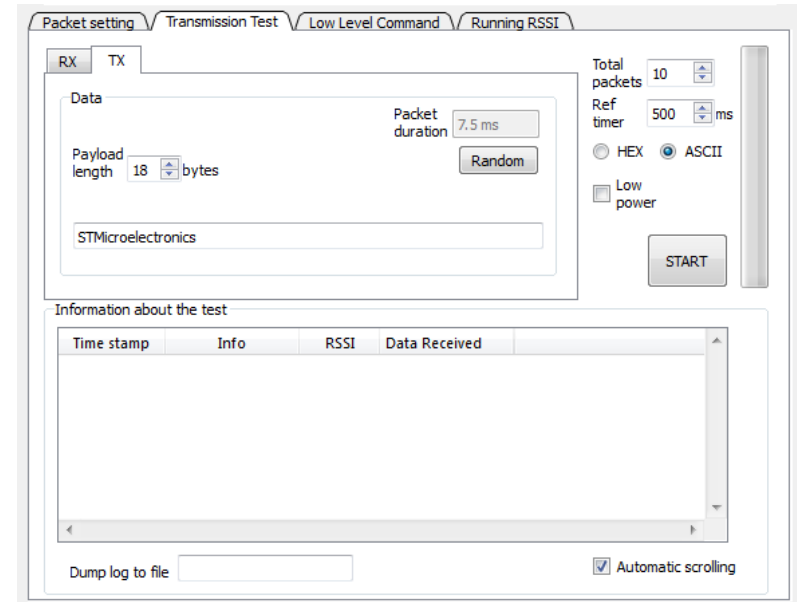
- The GUI can *Export* the the current register configuration. This will save all the registers to a .xml file.
- A configuration that has been exported can be imported using the *Import* button.

Transmission Test - TX

9

The TX tab allows to start the transmission routine.

- **Total Packets:** number of packets to be transmitted.
- **Ref timer:** the time period for the *S2-LP* to start a transmission slot.
- **Payload length:** length of the message. It is automatically updated when writing the message content on the payload line text
- Clicking on **START**, the transmission routine will be started:
 - the node will transmit a packet.
 - after the first packet is transmitted, it will go in IDLE state according to the figure below.
 - After the Ref timer has elapsed, another packets is TX.



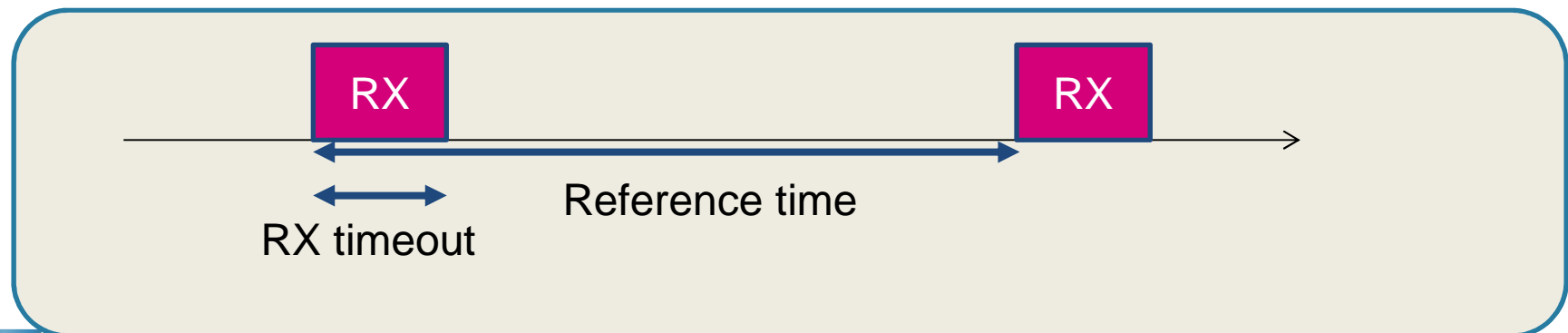
Transmission Test - RX

10

The RX tab allows to start the reception routine.

- **Total Packets:** number of packets to be received.
- **Ref timer:** the time period for the S2-LP to open the RX slot.
- **RX timeout:** duration of the RX slot.
- Clicking on **START**, the reception routine will be started:
 - the node will go in RX with infinite timeout.
 - after the first packet is received, it will go in RX according to the figure below.
 - If the TX has the same Ref timer and the RX timeout is greater than the SYNC and preamble duration, each packet will be received.

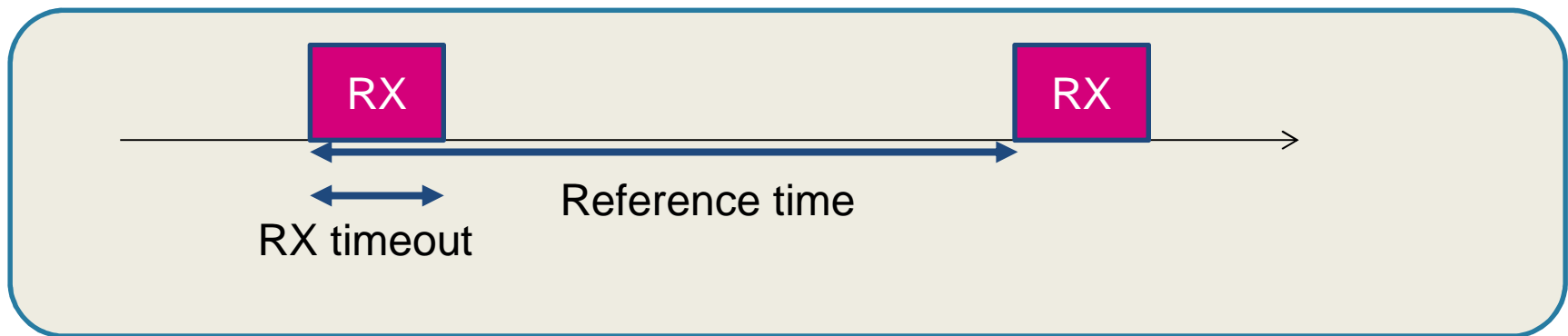
The screenshot shows the 'Transmission Test' window with the 'RX' tab selected. The 'Test indicator' section displays 'Packet received' as 0, 'Packet discarded' as 0, 'PER [%]' as 0, and 'RSSI [dBm]' as 0. The 'RX timeout' is set to 100 ms, 'RSSI threshold [dBm]' is -130, and 'Payload length' is 18 bytes. The 'Sniff mode' is set to 'Enable' with a 'WakeUp timer' of 3 ms and 'FastRx timeout' of 314 us. On the right, 'Total packets' is 10, 'Ref timer' is 500 ms, and 'Low power' is unchecked. A 'START' button is visible. Below the settings is a table titled 'Information about the test' with columns 'Time stamp', 'Info', 'RSSI', and 'Data Received'. At the bottom, there is a 'Dump log to file' checkbox and an 'Automatic scrolling' checkbox which is checked.



Transmission Test - RX

11

- During the un-active phase of the reference time, the device will go :
 - in READY, if the Low Power check is unset
 - in STANDBY, if the Low Power check is set

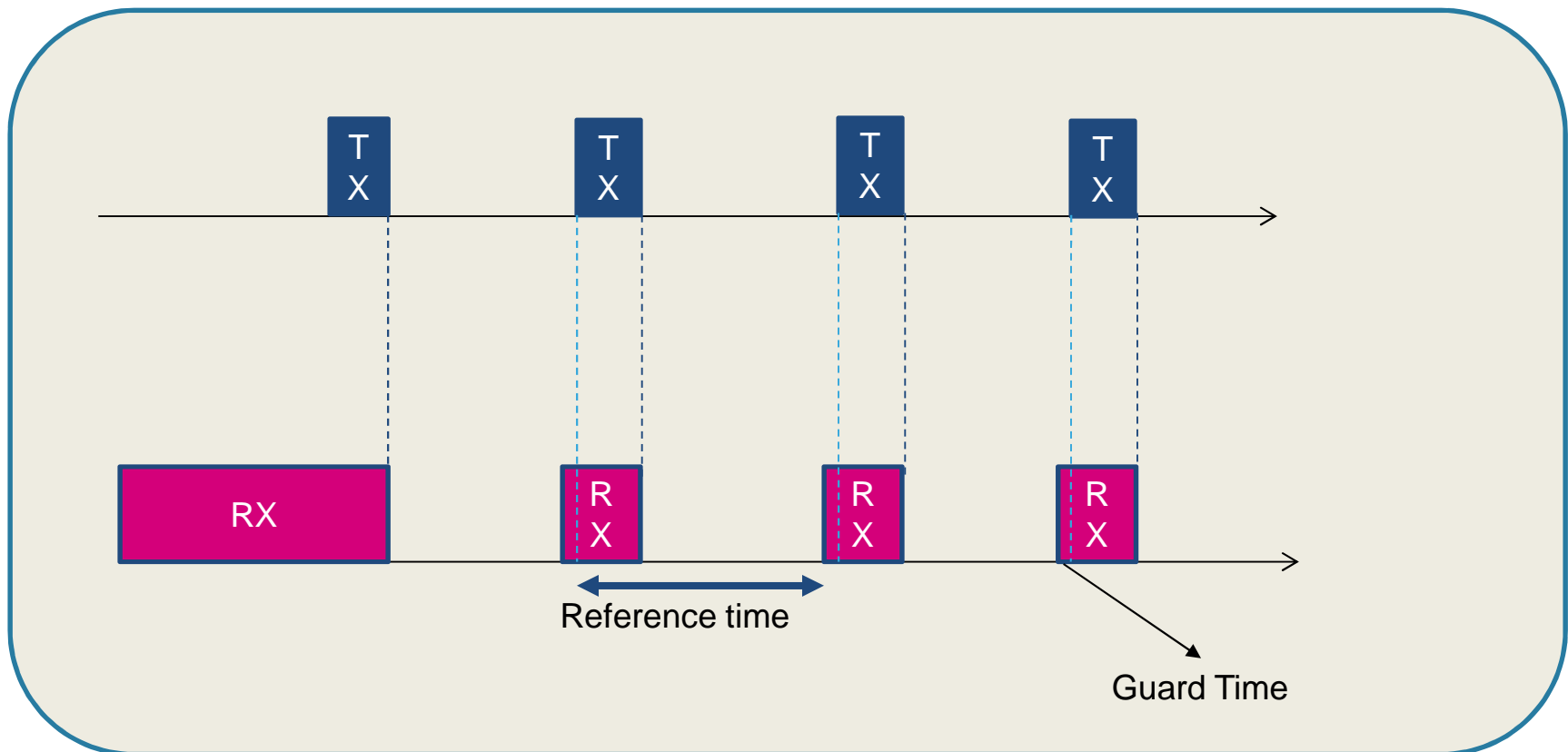


- **Special cases are:**
 - Reference time = 0 and RX timeout=0, in this case, the device will be set always in RX (so no slots, no READY nor STDBY states).
 - Packets number = 0 → receive infinite packets. The reception routine won't be aborted until the *STOP* button is pressed.

Transmission Test – TX and RX

12

- The RX must be started first.
- When the first TX packet is received, the RX will start its cycles of Ref Time (*un-active phase as desc. before*) and RX (*RX state*).



Transmission Test - RX

13

The screenshot shows a software interface for a transmission test. It includes a 'Test indicator' section with four read-only fields: 'Packet received' (0), 'Packet discarded' (0), 'PER [%]' (0), and 'RSSI [dBm]' (0). To the right of these fields is a 'Sense RSSI' button, highlighted with a red box and a blue '1'. Below this is a section with 'RX timeout' (100 ms), 'RSSI threshold [dBm]' (-130), and 'Payload length' (18 bytes). The 'RSSI threshold' spin box is highlighted with a red box and a blue '2'. At the bottom is a 'Sniff mode' section with an 'Enable' checkbox, 'WakeUp timer' (3 ms), and 'FastRx timeout' (314 us). The 'Enable' checkbox is highlighted with a red box and a blue '3'.

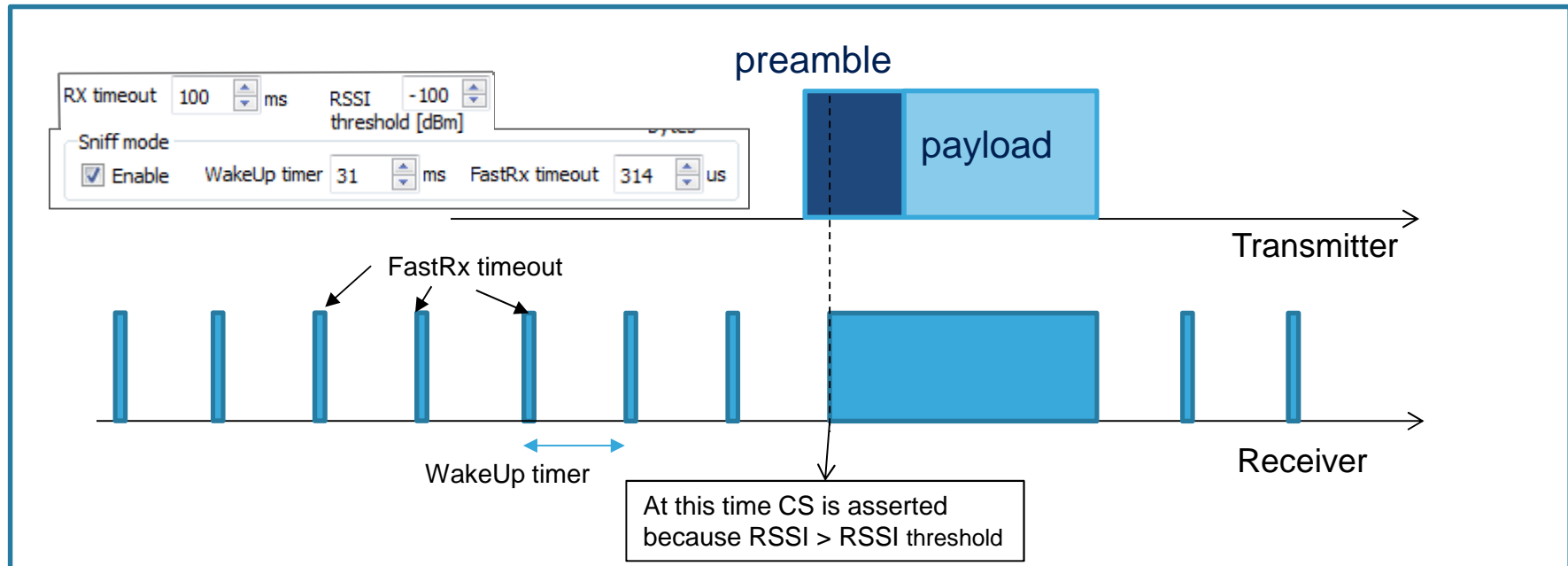
1. **Sense RSSI button:** used to sense the RSSI on the channel (that is set through the radio configuration part). If no signal is present, this gives an indication on the noise floor.

2. **RSSI threshold spin box:** sets the minimum RSSI threshold that the message should have. This is used to increase the performance of the receiver and avoid that noise can disturb the reception.
3. **Sniff mode check box:** this allows to switch the reception mode in sniff mode (also called *fast rx termination*).



Transmission Test – RX Sniff mode

14



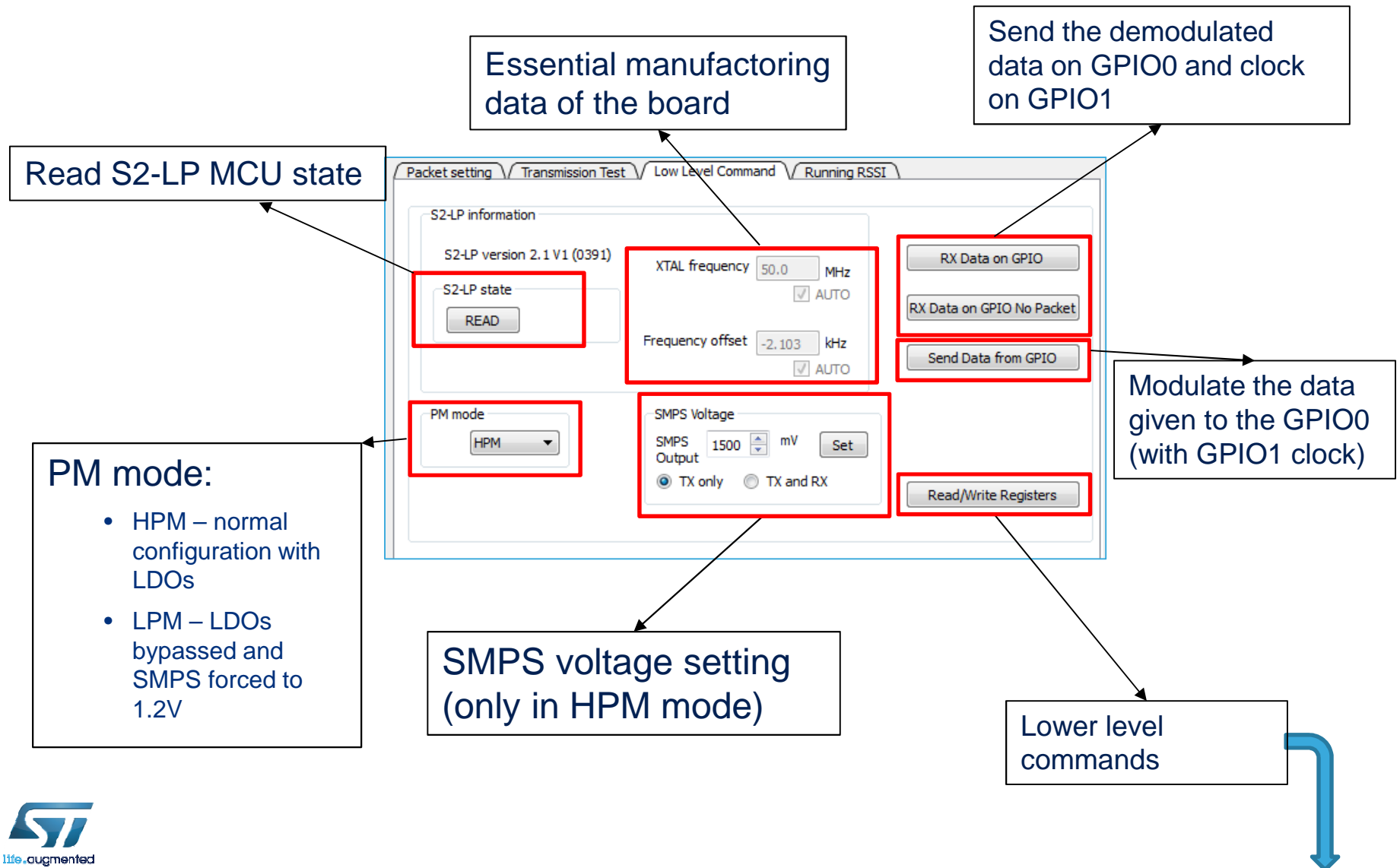
The receiver **wakes up** periodically and sniffs the channel.

- If RSSI is detected above the **RSSI threshold**, the receiver stays in RX and searches the SYNC word
 - If SYNC is detected, the packet is received
 - Else, the **RX timeout** elapses and the device is set to SLEEP again
- Otherwise it goes back to SLEEP

To ensure a correct reception, the preamble duration of the transmitted packet (TX side) should be **bigger than** the wake up time of the receiver

Low Level Command TAB

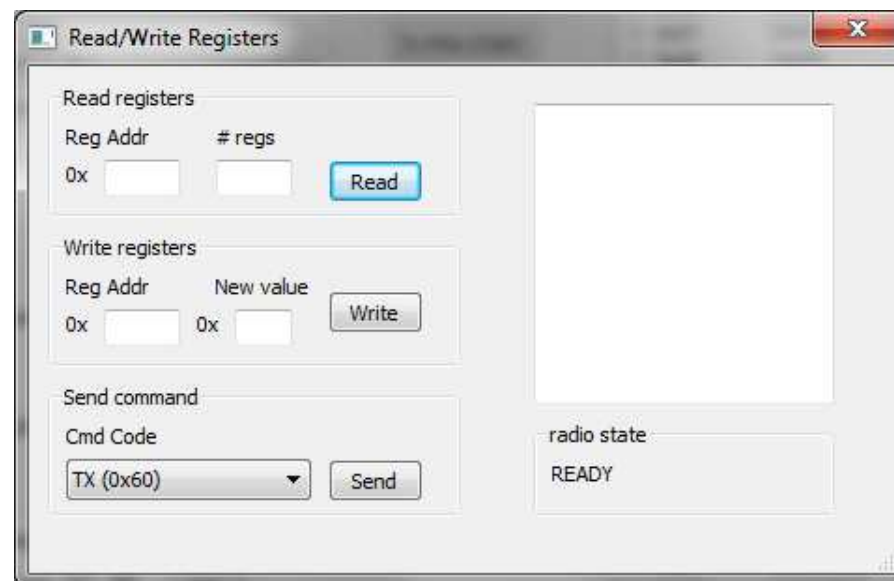
15



Read/Write registers dialog

16

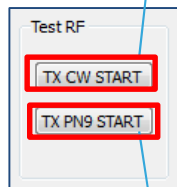
- It is a test mode tab that allows to:
 - *Read* registers
 - *Write* registers (without constraints of reserved fields)
 - *Send command* strobes to the device



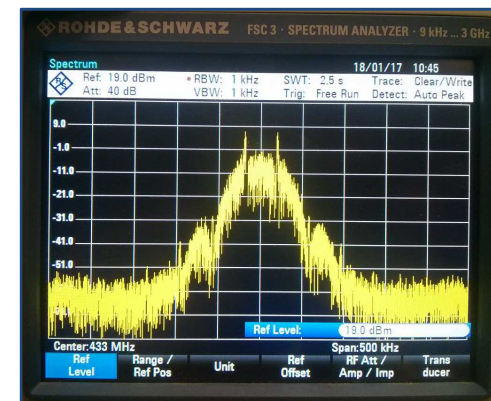
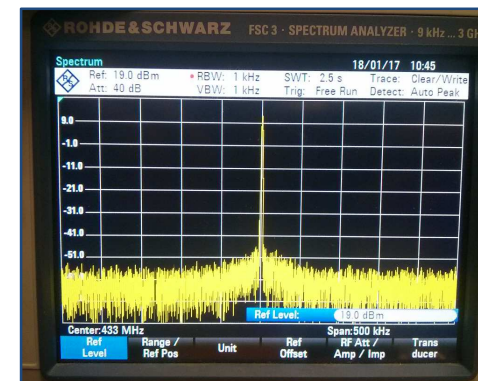
Measuring the TX power

17

- Connect the board to a spectrum analyzer centered to the base frequency selected in the GUI
 - Click on *TX CW START* to generate a tone (unmodulated carrier)



- Click on *TX PN9 START* to generate a PN9 modulated signal according to the parameters specified in the radio configuration section



Sensitivity test with the GUI

18

To run a sensitivity test with the GUI it is possible to use the “*BER option*” that many signal generators have (ex. *Agilent e4438C*).

For the low level command TAB click on the Send data on GPIO No packet and connect the instrument as follows:

