

LoRaWAN™ EVALUATION KIT

Code: 33000162

INTRODUCTION:

This kit has been developed to test the functionality and radio parameters of LoRaWAN™ transceivers 32001409.

Modules microcontroller has a **standard firmware**.

The unit interfaces with the PC via USB cable, and can be configured using a GUI.

Two 2.54mm pitch strips connected directly to the pins of the module allow a fast hardware connection with external devices.

1. KIT CONTENT

- 1 x demo board 32001382 with 32001409 (LoRaWAN™ transceiver)
- 1 x 915 MHz antenna with 90° connector
- 1 x USB cable

2. ABSOLUTE MAXIMUM RATINGS

External power supply (M1)	+ 3.7 V
RF input (SMA connector)	+10 dBm
Storage temperature	-10 ÷ +30
Operating temperature	-10 ÷ +50

3. ELECTRICAL CHARACTERISTICS

<i>Parameter</i>	<i>Min.</i>	<i>Typ.</i>	<i>Max.</i>	<i>Unit</i>	<i>Notes</i>
External supply voltage (M1)	2.4	3.3	3.7	Volt	

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4. DEMOBOARD INTERFACE DESCRIPTION

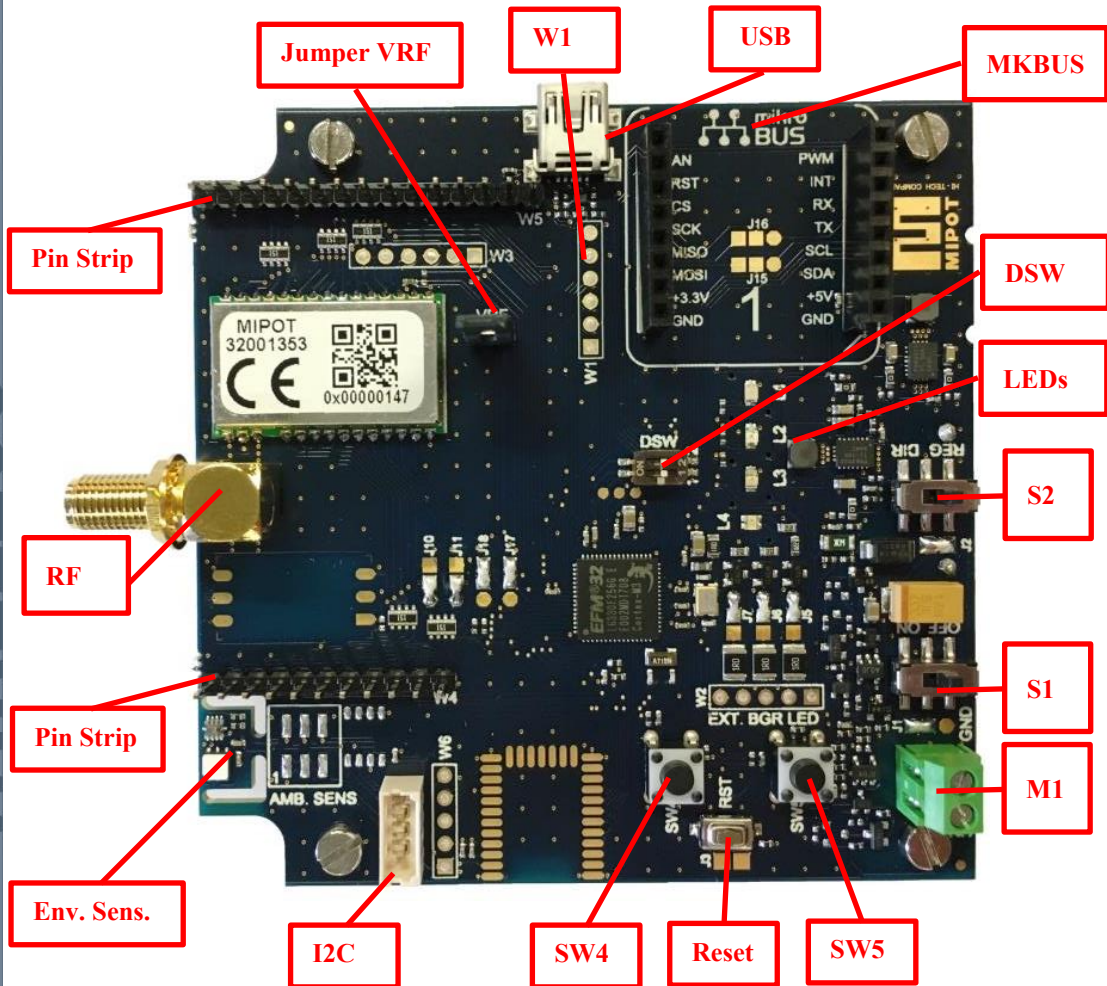
Interface	Description	Notes
M1	External supply terminal block	
USB	USB connector (standard type B)	
RF	RF input/output (standard SMA female)	Connect a 50 ohm antenna or RF load.
S1	Power supply ON OFF switch	
S2	Direct / Regulated voltage switch	
DSW	Dip-Switch	Functions vary according to application FW
RESET	Reset button	Reset button for the demoboard microcontroller
LED LD1	RED	Functions vary according to application FW
LED LD2	GREEN	Functions vary according to application FW
LED LD3	ORANGE	Functions vary according to application FW
SW4, SW5	Buttons	Functions vary according to application FW
VRF	Module supply jumper	Connect an ammeter for module current measurements.
PIN STRIP	2.54 mm pitch	Pins for direct connection to the module For module pin characteristics refer to module datasheet.
Env. Sens.	Environmental sensors	Temperature Relative Humidity Light Ultraviolet Index
MKBUS	MikroBUS socket	
I2C	I2C socket	
W1	Programming pads/connector	



RF
WIRELESS

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5. POWER

5.1 DEVICE POWER SUPPLY

Switch S1 on "ON" to turn on the demoboard.

The board can be power-supplied in 3 ways:

- by **2 x AA batteries** 1.5V (battery holder on the back of the board)
- via **external power terminal board M1**:
 - o **Neg.:** is the power supply common negative
 - o **2.4-3.6V:** connect this input to a 2.4 to 3.7V stabilized power supply
- Via **USB connector**

Notes:

- due to low voltages involved, supply paths are separated by **near-ideal diode circuitry**: **different power supplies** (USB, battery and M1) **can coexist**, the input with highest voltage has priority. Hysteresis is provided during transitions between different inputs.
- device is protected against polarity inversion

5.2 SUPPLY OPTIONS

The demoboard has two embedded switching regulators that provide stabilized +3.3V (for the logic, sensors, module and Mikrobus socket) and +5 volt (for the RGB LED and Mikrobus socket), regardless of input voltage.

5.2.1 Regulated supply

if S2 is in REG position, 3.3 V regulator is **enabled**.

5.2.2 Direct supply

if S2 is in DIR position, 3.3 V regulator is **disabled** (bypassed).

In this way all the board is supplied directly by the selected supply source (the 32001409 can be tested at extreme voltage limits).

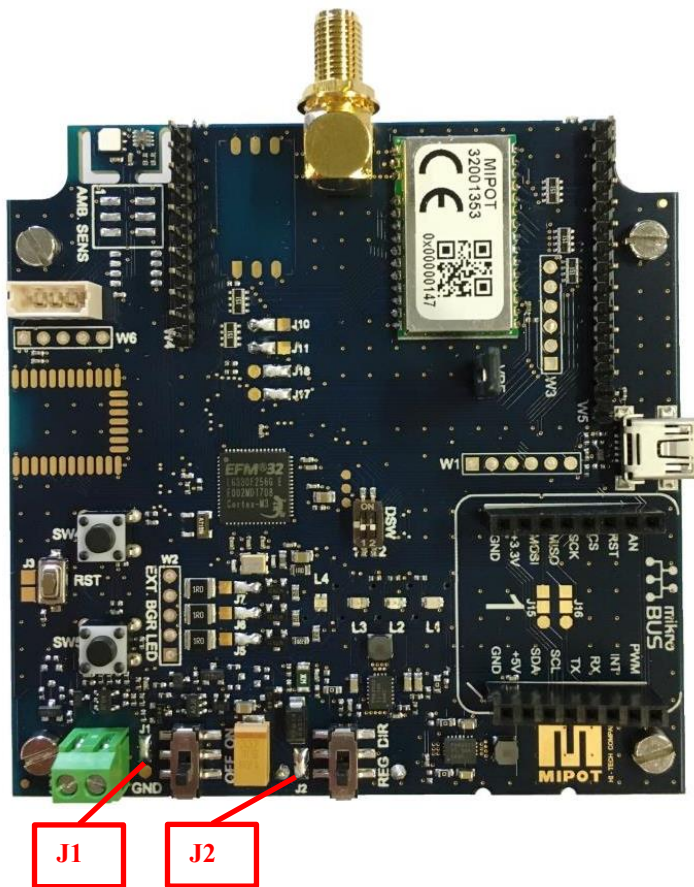
→ To select the unregulated power supply source place a solder jumper on J1 according to the following table:

Supply source:	Place a solder joint between:	Notes
Battery	1-2	
External (M1)	2-3	Default

NOTE: since USB is a 5 V power supply, in this configuration it is not connected to the logic, but remains connected to the voltage regulators in order to supply the RGB LED and the Mikrobús socket.

5.2.3 Minimize consumptions

In order to minimize the power consumption (for instance if you want to use the board as an environmental sensor), it is possible to disconnect the regulators by removing the solder joint on J2 and use the direct power supply as indicated in 5.2.2.



5.2.4 Measure 32001409 consumption

Remove RF jumper and connect an ammeter.

6. LEDs

6.1 EMBEDDED RGB LED

Board has an embedded RGB LED, PWM driven by the microcontroller through open collector BJT.

6.2 EXTERNAL RGB LEDs

It is also possible to drive external LEDs with their own power supplies by connecting to the EXT BGR LED pads and setting solder joints on J5, J6 and J7 according to the following table:

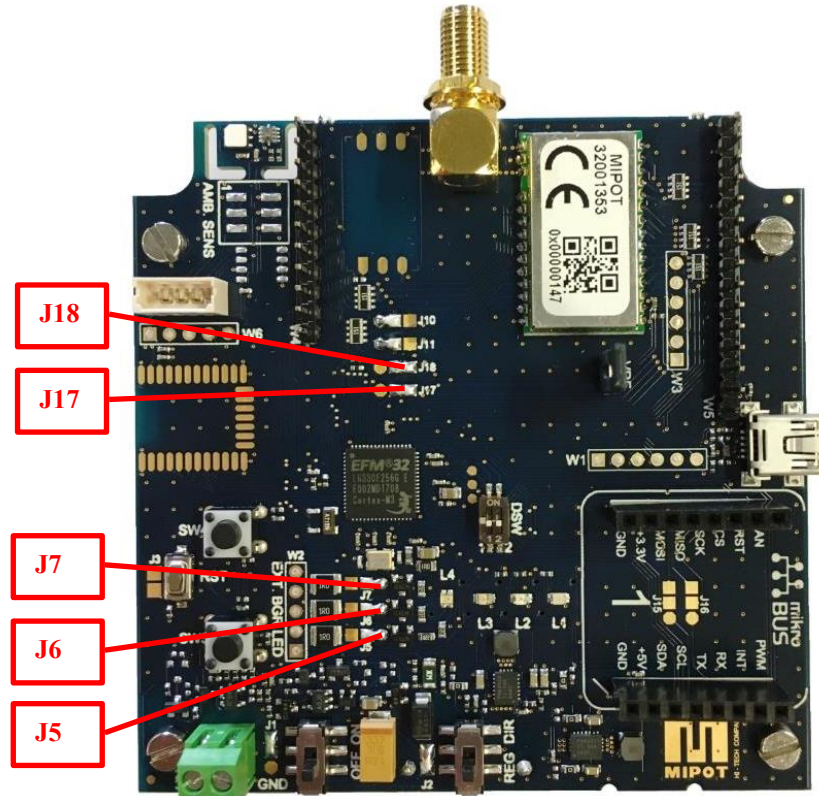
	Place a solder joint between:
On board LED	1-2
External LED	2-3

6.3 OTHER LEDs

L1 (red), L2 (orange) and L3 (green) LEDs are supplied. LED functions depend on firmware.

L1 and L2 can be connected either to the demoboard microcontroller or to the pin strips for external connection by setting solder joints on **J17, J18** according to the following table:

	Place a solder joint between:
Connection to 32001409	1-2
Connection to internal uC	2-3

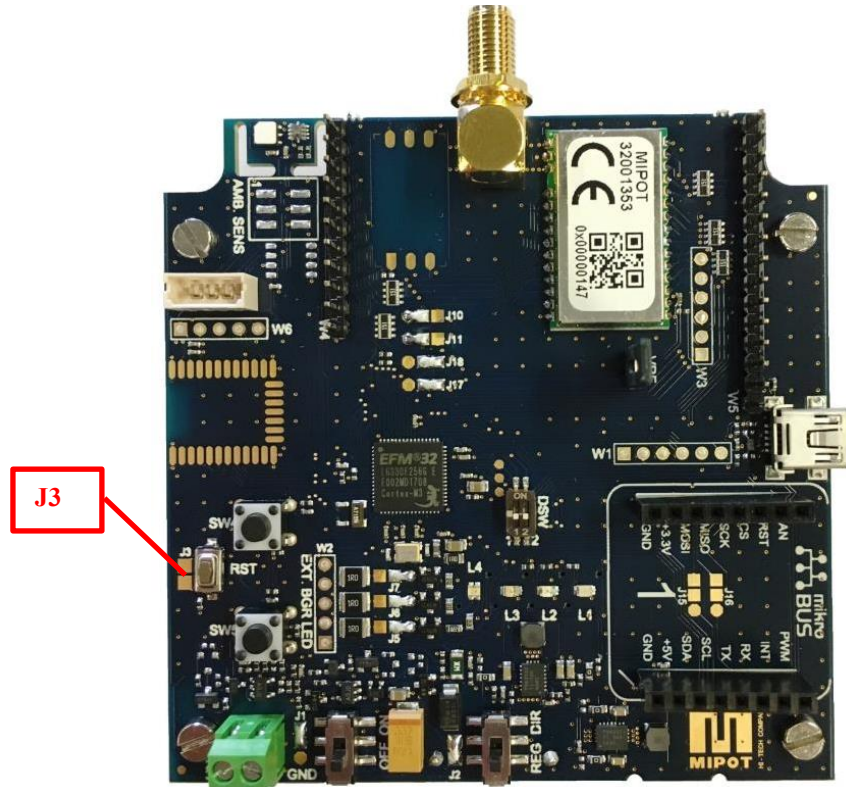


7. PIN STRIPS

7.1 W4 and W5 pin strips with 2.54 mm pitch are provided to directly interface with the pins of the 32001409 module. Resistors are provided in series with the lines in order to protect input pins from misconnections.

For direct connection with module, internal microcontroller must be put in reset by placing a solder joint on J3 according to the following table:

	Solder joint on J3 (embedded uC in reset):	Notes
Connection to external (pin strips)	Yes	
Connection to internal uC	No	Default



8. I2C CONNECTOR

I2C connector is provided for connection with external devices (e.g. sensors).

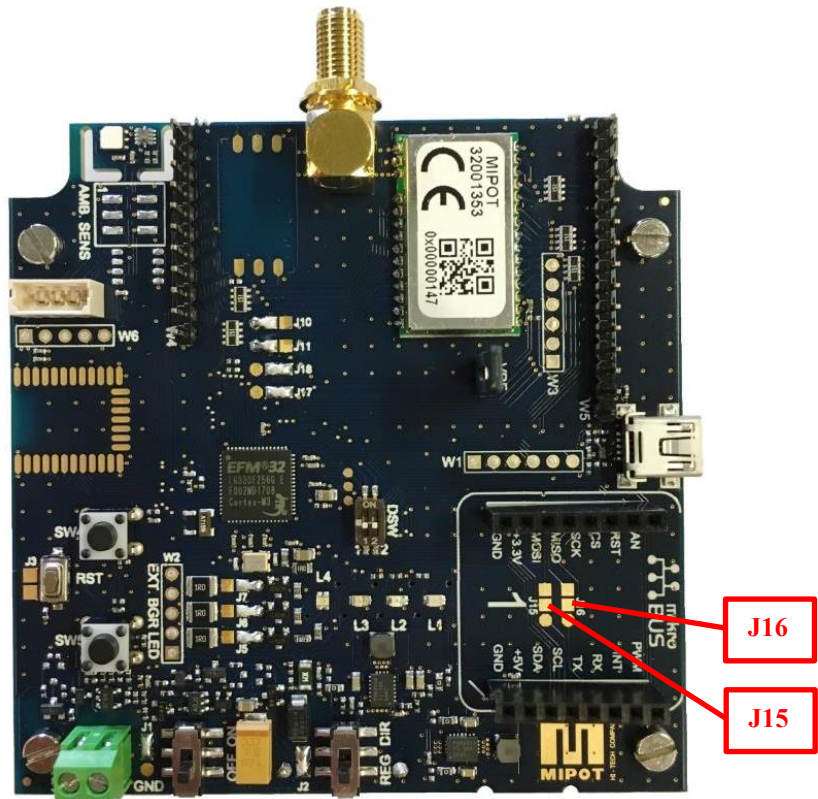
9. MIKROBUS SOCKET

A socket compatible with **Mikrobus** standard specification (see <https://www.mikroe.com/mikrobus/>) is provided in order to connect add-on modules compatible with this standard. 3.3V and 5V are provided together with standard signals. UART or SPI devices can be connected for communication with embedded microcontroller, and communication interface can be selected connection by setting solder joints on **J15**, **J16** according to the following table:

	Place a solder joint between:
UART	1-2
SPI	2-3

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10. uC PROGRAMMING PADS

Embedded microcontroller can be programmed through W1 programming pads. Signal sequence is:

Vcc
 SWCLK
 GND
 SWDIO
 NRST
 SWO

11. DIRECTIONS FOR USE

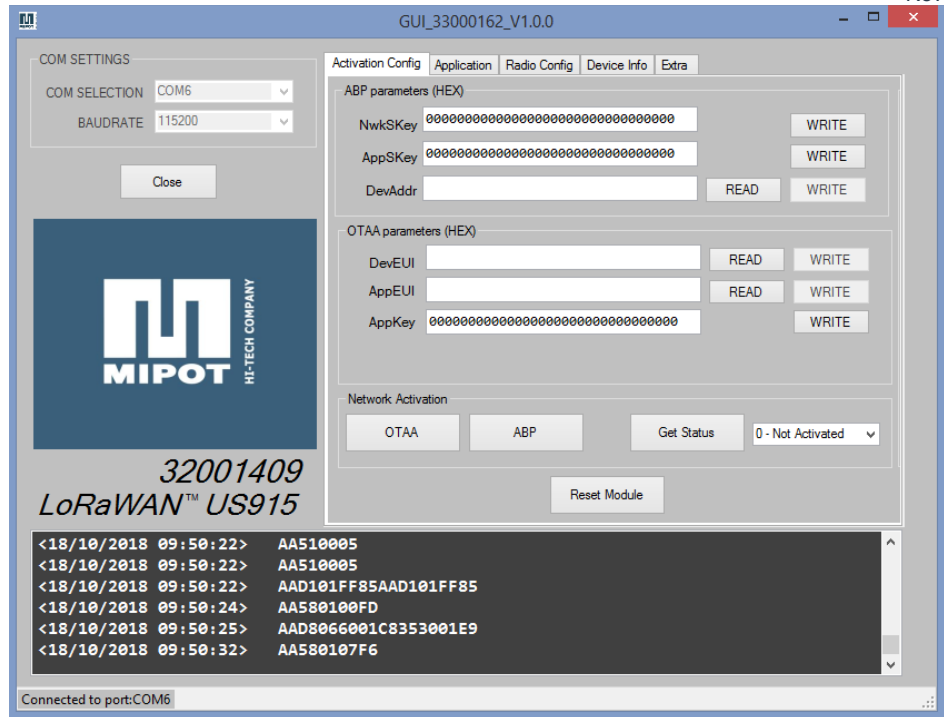
Warning: before connecting the demoboard or the USB dongle to the host PC via USB cable, **download and install Silabs CDC Virtual COM driver.**

Upon startup, application firmware on embedded **microcontroller detects if a USB host is connected to the board:**

- **If no** (no USB connection), it starts a demo application
 - The firmware tries to connect to a LoRaWAN network with the keys set on the module.
 - **Note regarding DSW DIP SWITCH.** In this application its function is:
 - DIP2 ON = ABP activation
 - DIP2 OFF = OTAA activation
 - DIP1 ON = Unconfirmed messages
 - DIP1 OFF = Confirmed Messages
- **If yes** it operates as a bridge between host PC and 32001409 module:
 - Through the serial you can configure the module, in particular you can set the authentication keys, besides any other parameter
 - The provided Graphical User Interface allows you to quickly set up the module:

11.1 Module configuration through the GUI:

Connect the demoboard to the PC, open the GUI and select the proper COM port, then click "OPEN":



In this tab you can:

- set up the activation parameters of the module:
 - Activation by Personalization (ABP)
 - Network Session Key (write only for security reasons)
 - App Session Key (write only for security reasons)
 - Device Address
 - Over the Air Activation (OTAA)
 - Device EUI
 - App EUI
 - App Key (write only for security reasons)
- join the LoRaWAN network by clicking "OTAA" or "ABP" if the previous parameters are correct (remember that Joining is not automatic when USB is connected).
- check the status of the node by clicking "Get Status".

NOTE: For details regarding module's parameters refer to "32001409 Uart Commands Reference Specification".

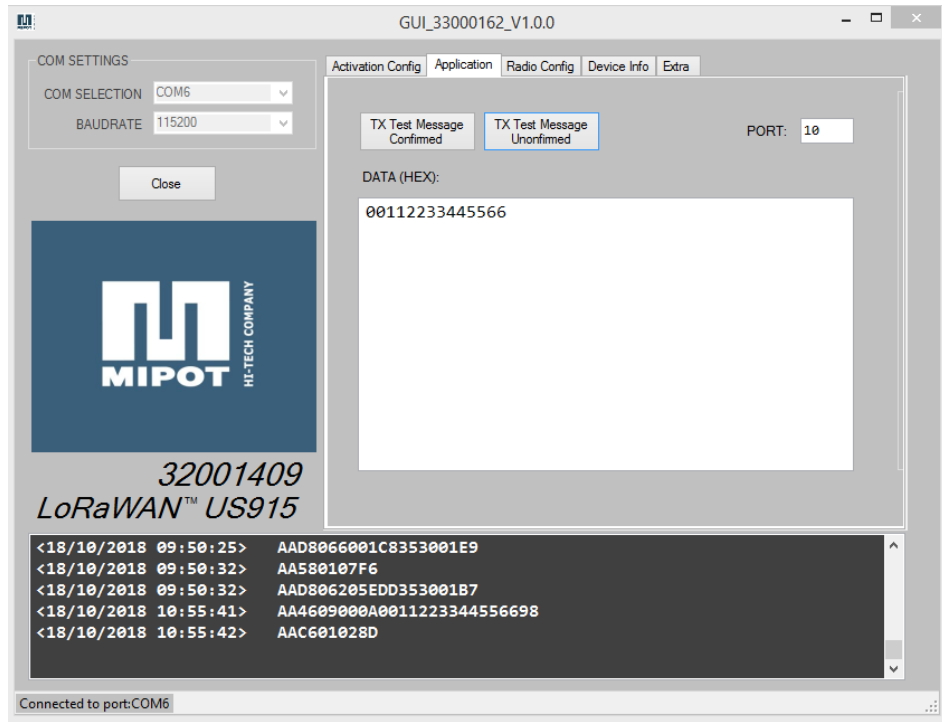
NOTE: to check if the module is connected, verify that each input command has an answer in the petrol green box below.

NOTE: in order to write parameters, the status of the module must be "0 - Not Activated"

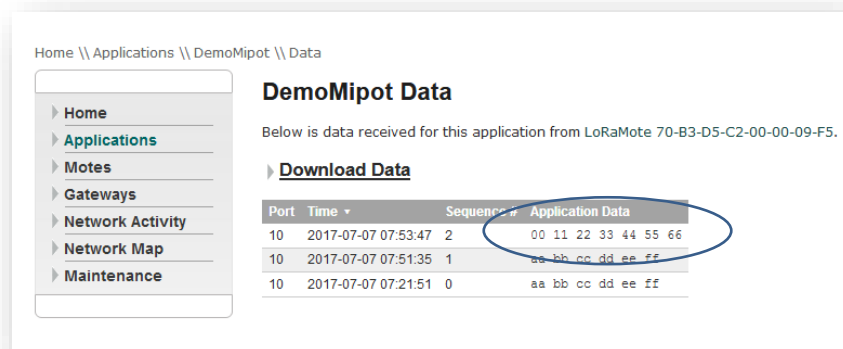
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By clicking on the "Application" tab you can send messages to the Application Server:



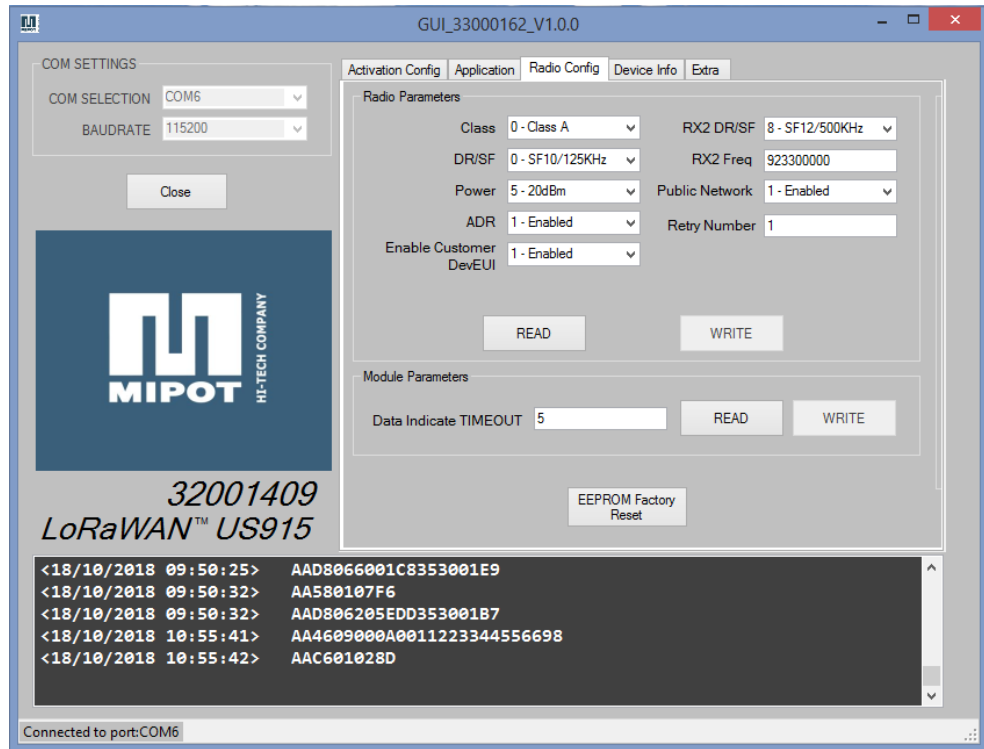
In the following image you can see the received message on an example of App Server webpage:



RF WIRELESS

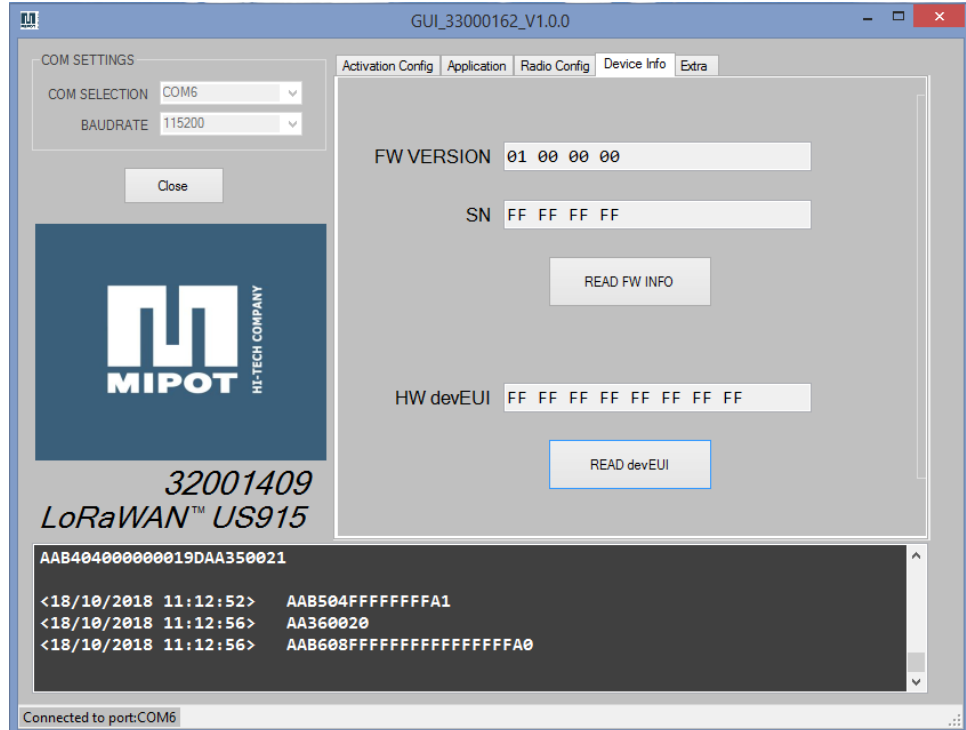
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By clicking on the "Radio Config" tab you can read or configure the radio parameters of the module:



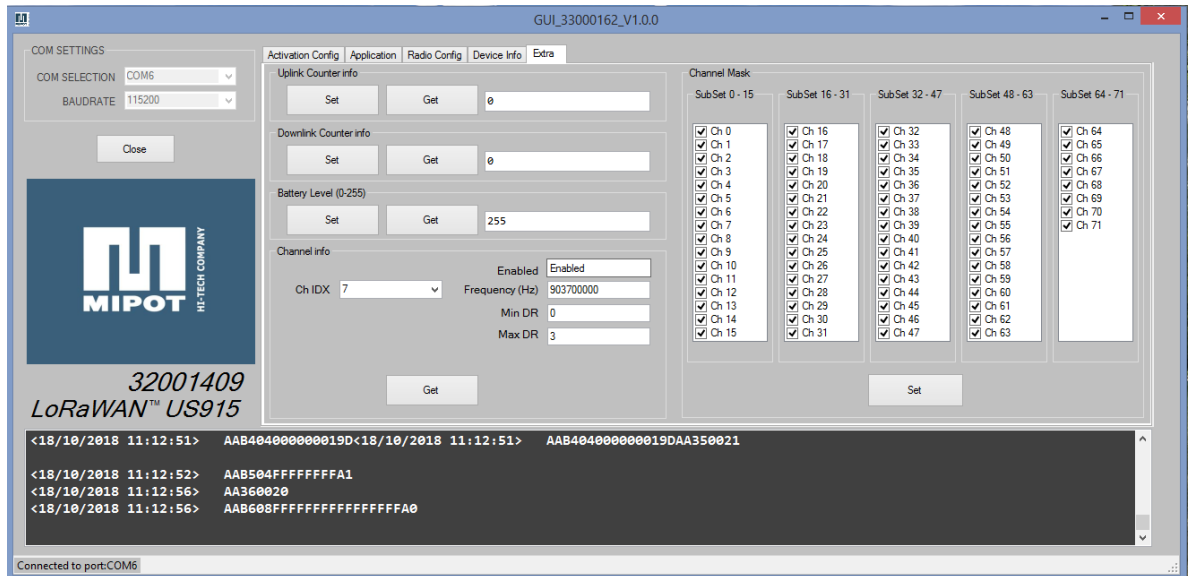
NOTE: For details regarding radio parameters refer to LoRaWAN specification on <https://www.lora-alliance.org/>.

By clicking on the "Device Info" tab you can read some parameters of the module:



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By clicking on the "Extra" tab you can read some extra information about the module:



11.2 Example of connection with the Application Server.

NOTE: in the following example we used a demo Gateway implementing both Network and Application Server. Data are visualized on an IP page generated by GW.
GW IS NOT SUPPLIED IN THE KIT.

NOTES on auxiliary LEDs on the demoboard:

- **LED L1 (RED):** when ON indicates that microcontroller is running
- **LED L2 (VERDE):** ON when module is in RX
- **LED L3 (GIALLO):** ON when module is in TX

NOTES on SW4 and SW5 on the demoboard:

- **A short pressure on one of this button forces the transmission, if duty cycle feature is disabled (no need to wait for transmission window). If duty cycle feature is enabled, transmission will be performed when duty-cycle timeout has expired.**

Configure the Gateway (GW) with the module parameters for OTAA or for ABP. They must correspond to the data configured in the GUI in paragraph 11.1.


Turn on the demoboard without connecting it to the PC: application firmware, without finding the USB connection, **automatically starts the OTAA procedure.**

Now application server will display data sent by module. Demoboard is programmed to send environmental data every 30s:

- **Temperature**
- **Relative Humidity**
- **Light**
- **Ultraviolet Index**
- **Battery voltage**

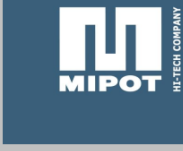
The Application payload has the following format:

```
Payload[0] = 0x41;
Payload [1] = app_FcTxCounter.uv8[0];
Payload[2] = app_FcTxCounter.uv8[1];
Payload[3] = app_FcTxCounter.uv8[2];
Payload[4] = app_FcTxCounter.uv8[3];
Payload[5] = vBat & 0x00FF;
Payload[6] = (vBat>>8) & 0x00FF;
Payload[7] = (vBat>>16) & 0x00FF;
Payload[8] = (vBat>>24) & 0x00FF;
```



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32001409
LoRaWAN™ US915



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```

Payload[9] = tempData & 0x00FF;
Payload[10] = (tempData>>8) & 0x00FF;
Payload[11] = (tempData>>16) & 0x00FF;
Payload[12] = (tempData>>24) & 0x00FF;
Payload[13] = (rhData) & 0x00FF;
Payload[14] = (rhData>>8) & 0x00FF;
Payload[15] = (rhData>>16) & 0x00FF;
Payload[16] = (rhData>>24) & 0x00FF;
Payload[17] = (ambLight>>0) & 0x00FF;
Payload[18] = (ambLight>>8) & 0x00FF;
Payload[19] = (ambLight>>16) & 0x00FF;
Payload[20] = (ambLight>>24) & 0x00FF;
Payload[21] = uvIndex;
Payload[22] = RedLedPwmState
Payload[23] = GreenLedPwmState
Payload[24] = BlueLedPwmState

```

It is also possible to turn on the RGB LD sending command on PORT 3 (Downlink Payload = {0x40, RED, GREEN, BLUE} where 0x40 is the op code, RED, GREEN, BLUE are 8 bit PWM):

NOTE: As per LoRaWAN Specification, the refresh of displayed / transmitted data is every 30 seconds. It is possible to force transmission by the node by clicking SW4 or SW5.

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