Figure 1

Contents

1. Overview

The board uses two 1.5V AA batteries. In order to let the display working properly the battery level shall be greater than 2.2V, ideally between 2.4V and 3V.
The battery level is always shown on the bottom left at the power on menu, see Figure 2.

Insert the radio module in his socket with the PCB component side facing out as shown in Figure 1.

The DEMO RTX-24EM-HP is available in the following variants:

Aurel Code	Technical name reference	Description
650201526G	AUREL DEMO RTX-24EM-HP	Demo for high power module RTX-24EM-HP-AI/V

2. Menu

At power on, the display will show the following initial menu:
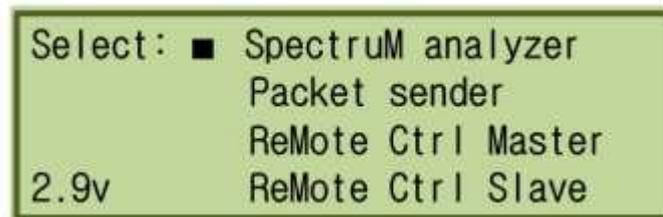
Figure 2

Pressing the button MENU permits to enter in the different topics available. Then, the button SELECT to navigate between topics.

2.1 Spectrum Analyzer

By selecting the *Spectrum Analyzer* mode it sweeps the RTX-24EM-HP module's frequencies separated by 20 channels defined between 2401.5 MHz to 2477.5 MHz. The corresponding RSSI is graphically displayed as per Figure 3. The buttons MENU and SELECT change the refreshing time from 0 to 9; "9" means max hold mode.
Pressing both MENU and SELECT switches to a Continuous Stream Mode shown in Figure 4. In this mode, the module is constantly sending random data with a 72kbps bit rate and the maximum RF transmission power (+18dBm). The transmitting channel number is shown in the upper right corner.
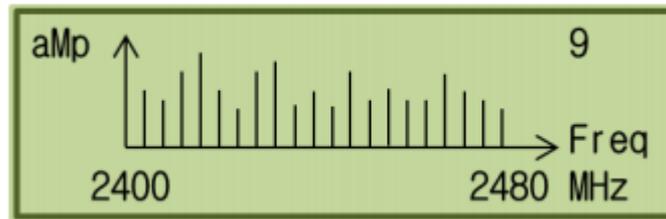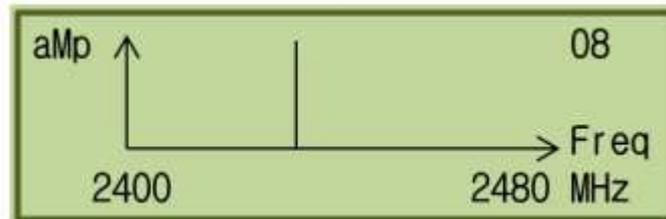
Figure 3

Figure 4

The transmission channel can be increased or decreased (with the buttons SELECT and MENU) between 0 and 19 corresponding to the frequencies shown in
Table 1. Pressing again both MENU and SELECT together switches back to the *Spectrum Analyzer Mode*.

CHANNEL	FREQUENCY [MHz]
0	2401.5
1	2405.5
2	2409.5
3	2413.5
4	2417.5
5	2421.5
6	2425.5
7	2429.5
8	2433.5
9	2437.5
10	2441.5
11	2445.5
12	2449.5
13	2453.5
14	2457.5
15	2461.5
16	2465.5
17	2469.5
18	2473.5
19	2477.5

Table 1 : Channels and Frequencies

2.2 Packet Sender

This application permits to transfer small data packets between two demos, one set in Master Mode and the other one in Slave Mode. The transmission is done from master to slave, the payload size is fixed at 4 bytes:

- Byte 0:   0x00
- Byte 1:   Counter Value MSB
- Byte 2:   Counter Value LSB
- Byte 3:   CRC Value

The RF transmission power is set to the maximum value (+18dBm).The slave module waits an incoming packet from the Master and it answers with an acknowledgment packet. An example of the display is shown in Figure 5.
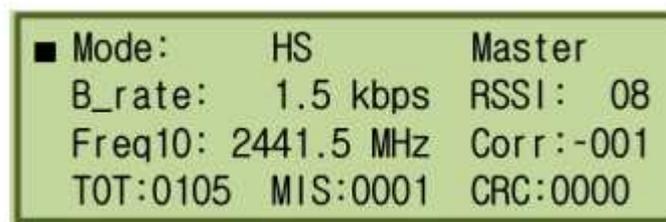
Figure 5 : Packet Sender display

Pressing the button SELECT moves the cursor in all the parameters available such as:

- Mode   :   switch between high sensitivity (HS) and normal sensitivity (NS).

- Slave/Master   :   switch between the two modes.
  The slave module waits 200 ms of timeout. When it receives a packet, the CRC is calculated and a 4 byte acknowledgement is sent to the Master.
  The master module continuously transmit 4 bytes of data every 200 ms of time interval.

- B_rate   :   Select the available bit rates,
  1.5 – 3 – 6 – 12 kbps in high sensitivity mode (HS).
  1.5 – 3 – 6 – 12 – 24 – 48 – 72 kbps in normal sensitivity mode (NS).

- Freq   :   Switch between the different channels as indicated in the
- Table 1.

  An auto-calibration is performed each time that this parameter is changed.

- TOT,MIS,CRC   :   TOT is increased for every packet received,
  MIS counts the timeouts triggered without a packet received,
  CRC counts the bit error in the packets received.

- RSSI   :   This number shows the received signal strength.
  It's in logarithmic scale, from 0 to 9.

- Corr : Amount of frequency correction provided during the reception (HS only). It spans between -127 and +127. Each step is 790 Hz.

2.3 Remote Control Master/Slave

2.3.1 Master/Slave characteristics

Two boards implemented as *Remote Ctrl Master* and *Remote Ctrl Slave* communicate with a 1.5kbps in high sensitivity mode (HS) and the maximum RF transmission power (+18dBm). The transmission is redundant in order to have the highest probability of success. The payload size is fixed at 1 byte, the first half is the data and the second half is computed using a Cyclic Redundancy Check (CRC), see Table 2.

Binary code	Hexadecimal code	CRC full byte
0000	0 for OFF	0F
0001	1 for ON	1E
1010	A for ASK	A5

Table 2

In order to cover the full ISM 2.4 GHz band, three hopping frequencies have been selected:
- Channel 0 : 2401.5 MHz
- Channel 10 : 2441.5 MHz
- Channel 19 : 2477.5 MHz

The hopping rate has been set at 190ms for the Master and 500ms for the slave. It can be optimized in function of the particular application and environment.

Figure 6 Timing diagram of the frequency hopping protocol

The Slave module hops regularly and it is always listening. When it receives a packet from the Master with a correct CRC, it sends back an answer on the same channel. If the Master receive a packet with a correct CRC, its displays the status received and disable the transceiver. Otherwise, the Master continues to transmit the same packet following its own frequency hopping scheme until the timeout of 5 seconds.

2.3.2 Master/Slave display functions

Figure 7 ON and OFF status of the slave module

This application permits to remote control a slave board using a master board. The commands are simplified in order to focus on the sensitivity of the transceiver and its communication protocol.

From master side it's possible to interact with the slave with three simple commands:

- Ask the status   :   the slave will answer if it's in ON or OFF status

- Turn ON   :   this command will switch the slave module in "*on status*"

- Turn OFF   :   this command will switch the slave module in "*off status*"

Moreover, on the top, the display shows different working frequencies (2401.5 – 2441.5 – 2477.5 MHz) on which the slave is permanently hopping and listening for commands from the master.

The technical characteristics can change without notice. AUR°EL S.p.A doesn't assume the responsibility to the damages caused by an improper use of the device.

Pressing the MENU button on the slave it will change its status (ON or OFF) without a notification to the master.

The master module shows the working frequencies (2401.5 – 2441.5 – 2477.5 MHz) and the number of received packets.

Pressing the SELECT button permits to switch between different commands. If the button MENU is pressed the selected command is activated.

Each command has an hexadecimal byte used as identifier, as per Table 3.

Hexadecimal ID	Meaning	
	From Master	**From Slave**
0x0F	Turn OFF the slave	Slave is OFF
0x1E	Turn ON the slave	Slave is ON
0xA5	Ask the status of the Slave	*** not used ***

Table 3 : Packets meaning

ICON	STATUS	NOTE
	OFF	The master has received the information that the Slave is OFF.
	ON	The master has received the information that the Slave is ON.
↑	sendInq ■ ■ ■	The Master is sending a command to the Slave in each frequency, till it receive a response.
✗	TIME Out	If the Master doesn't receive a packet after 5 seconds.
?	unknown	At startup or when a meaningless packet has been received.

Table 4 : Icon displayed on master side

3.   Revision History

Date	Description	Revision
13/11/2018	Preliminary	A
19/11/2019	First Release	B