

How to modify the 2.4GHz output power ?

The EM9301 output power can be adjusted in 8 steps from -20dBm to +3dBm allowing to reduce the current consumption and then to increase the battery lifetime, or to optimize the communication distance.

It can be achieved using the EM-specific HCI command `EM_SET_RF_POWER_LEVEL` (OGF=0x3F, OCF=0x05). Please refer to the datasheet section 10 for details.

This output power configuration will be used for the next advertising event or connection event, following the command reception, as long as a reset has not been executed. The default output power is 0dBm.

I do not see the 2.4GHz output power vary in LE_TRANSMITTER_TEST mode using this command. Why?

The `EM_SET_RF_POWER_LEVEL` command allows to modify the output power in advertising or connected state. In `LE_TRANSMITTER_TEST` mode, the output power is set to its maximum in order to allow regulatory and compliance testing.

However, it is possible to modify the output power in `LE_TRANSMITTER_TEST` mode using EM test commands. Please contact directly EM Microelectronic.

How to use the LE_TRANSMITTER_TEST command?

The EM9301 can send data packets of defined data (0101..., 00001111, all 0, all 1, random...) at a precise frequency: it is the so-called `LE_TRANSMITTER_TEST`, defined by the Bluetooth SIG.

Opcode: 0x201E

Parameters:

-frequency: 0xN, with $\text{Freq} = 2042 + (N * 2\text{MHz})$. N range: from 0x00 to 0x27.

-length of test data: number of bytes in the payload data of each RF packet. From 0x00 to 0x25.

-packet payload: type of data:

0x00: pseudo-random bit sequence 9

0x01: "11110000" data

0x02: "10101010" data

0x03: pseudo-random bit sequence 15

0x04: all "1"

0x05: all "0"

0x06: "00001111" data

0x07: "01010101" data

To terminate the `LE_TRANSMITTER_TEST` mode, the command `LE_TEST_END` shall be send (opcode 0x201F).

Do I need to tune the crystal loading capacitors? How to proceed?

The PLL oscillation frequency directly depends on the crystal oscillation frequency. It means that if the actual crystal frequency is shifted with respect to 26MHz, the 2.4GHz signal will be also shifted, but to a larger extent, which might provoke interoperability issues or even non-BT compliance. Even if EM Microelectronic reference design is followed, the choice of different crystal, of other capacitor manufacturer or the parasitics implied by the PCB design might have an impact on the crystal oscillation frequency.

The EM9301 can generate a non-modulated 2.4GHz signal for this purpose. Then the crystal loading capacitors can be modified in order to set the 2.4GHz at the targeted frequency. Please contact directly EM Microelectronic for the procedure to enter this test mode.

Are there any requirements for the 26MHz crystal?

The 26MHz crystal accuracy must be +/-50ppm, as stated in the EM9301 datasheet. This is applicable to the whole 26MHz reference clock block accuracy, which means that the variation of the crystal frequency itself across manufacturing process, temperature and aging effect have to be considered, in addition to the effect of the precision of the crystal's loading capacitors on this 26MHz frequency.

Please refer to EM Microelectronic's application note for a calculation guide.

Q : There are a lot sleep modes. What are those modes and how to use them?

A : There are 2 different types of sleep modes: in case of connected states and of non-connected states.

In connected state the EM9301 automatically handles the transitions between RF activity and sleep mode (BLE Sleep) to save power consumption. This is done with a precise timing, which is ensured by either a Xtal oscillator, or a RC oscillator to further decrease the power consumption: this is the so-called BLE sleep mode with RC oscillator.

This mode can be enabled using the EM specific HCI command `EM_POWER_MODE_CONFIGURATION` (OGF=0x3F, OCF=0x06) as described in section 10.5 of the datasheet. By default the EM9301 uses the Xtal oscillator as clock source for the BLE sleep mode. This mode is available only in case the SPI is used as transport layer, since the UART uses the 26 MHz Xtal frequency. The behavior is dynamic and BLE Sleep mode is activated only if the system stays there for more than 15ms.

In non-connected states, two sleep modes are available: Sleep mode and Deep-Sleep mode.

In Sleep mode the 26MHz Xtal is switched off and the RC oscillator kept, whereas in Deep-Sleep mode the RC oscillator is switched off. The Deep-Sleep mode is the lowest current consumption mode. In this mode, the EM9301 state and registers contents are kept.

In both Sleep mode and Deep-Sleep mode a limited set of HCI instructions is accepted at a limited speed. These modes can be entered executing the EM specific HCI command `EM_SET_POWER_MODE` (OGF=0x3F, OCF=0x03). In these modes the EM9301 can only switch to the idle mode using the same EM specific HCI command `EM_SET_POWER_MODE` if the selected transport layer is SPI, or setting the WU pin to 1 in case the UART is used.