Technical Description

General

The EUT is a gift which is snowman shaped. It will play songs and move in time to the song. There are totally four snowman styles. When it is put together with other members of the band, they communicate wirelessly to move in time and play along with each other's songs.

Digital Circuit

- U3 (S-1112B33MC-L6STFG) and associated circuit act as the voltage regulator.
- U1 (SNC82120) and associated circuit act as the MCU to play the songs, control the motion and communicate with RF module.
- L1 and L2 are the coils to make the snowman move.

RF Module

The channel frequencies of the EUT are 2406MHz, 2438MHz and 2452MHz only. The IC EM9201 and associated circuit act as the RF transceiver module. EM9201's TX-chain features a completely on-chip GFSK transmitter based on direct synthesis of the RF-signal directly applied to the 2.4GHz power amplifier. The radio (RF-core) of the EM9201 features a highly integrated multi-channel RF transceiver for wireless applications in the world-wide ISM frequency band at 2.4000 – 2.4835 GHz. It has a robust low-IF architecture and the direct GFSK modulation scheme.
The radio core can be programmed to be in two main states:
- TX state: the whole transmit-chain is active and the digital baseband data can be up-converted to a 2.4GHz GFSK
modulated signal
- RX state: the frequency synthesizer and the whole RX-chain are active and ready to receive a packet.
The RF-core is built-up of three major sub-systems:

1. Frequency synthesizer (PLL):

The frequency synthesizer provides accurate and low jitter 2.45 GHz RF signal used both for the up-conversion process in TX state and for the down-conversion of an on-air RF signal in RX state. Up to 40 different frequencies can be synthesized. In order to support direct GFSK- modulation in transmit-operation with low frequency drift, its architecture is based on a closed loop modulation approach. For proper centring of the VCO control voltage an auto-calibration mechanism is included in the PLL. Furthermore, the PLL lock-status can be read from outside the chip using a corresponding SPI read command.

2. RX-chain

High sensitivity (-83dBm for 1Mb/s) RF-reception at 2.45 GHz is achieved by using a low noise resonant RF-amplifier (LNA), followed by a down-conversion mixer and an IF-filter. The output of the IF-filter is fed to a limit-amplifier, whose digital I/Q signals stimulate the subsequent digital GFSK-demodulator. At the demodulator output, received packet data and status information is available, which finally is fed to the digital baseband. The RX-chain also features a receive-signal-strength indicator (RSSI), which can measure the down-converted RF-power after the IF-filter. Its averaged value can be read through the SPI after the single-shot RSSI measurement has been completed.

3. TX-chain

The TX chain consists on a GFSK modulator which is included in the frequency synthesizer and a Power Amplifier (PA) output stage.