Technical Description

The Equipment Under Test (EUT) is a 2.4GHz Transceiver (Helicopter Unit) for a RC helicopter operating at 2412 – 2469MHz with 1 MHz channel spacing. The EUT is powered by 1 X3.7V rechargeable battery (Li-Poly). After switch on the EUT and paired with controller, the EUT can be controlled to fly forward, backward, turning left and right direction by the corresponding controller. To charge the internal battery in the helicopter, either plug the charging connector from the controller into the charging jack on the helicopter for starting the charge process or using USB charging cable for charging via PC.

Operating Frequency Band: 2412MHz ~ 2469MHz
Modulation Method: GFSK.
Channel Spacing: 1MHz

The functions of main ICs are mentioned as below.
1) U3 & Q1 acts as Battery Charger
2) U1 Acts as Regulator
3) U4 acts as motion sensor
2) U2 (CWRFE1R) acts as 2.4GHz RF transceiver module
3) U5 & U6 acts as motor driver
4) Y1 acts as 16MHz Clock Oscillator.
5) NRF24LE1 acts as 2.4GHz RF Transceiver.

Antenna used:

PCB Antenna has been used.

3 RF transceiver

The nRF24LE1 OTP uses the same 2.4 GHz GFSK RF transceiver with embedded protocol engine (Enhanced ShockBurst™) that is found in the nRF24L01+ single chip RF transceiver. The RF transceiver is designed for operation in the world wide ISM frequency band at 2.400–2.4835 GHz and is very well suited for ultra low power wireless applications.

The RF transceiver module is configured and operated through the RF transceiver map. This register map is accessed by the MCU through a dedicated on-chip Serial Peripheral interface (SPI) and is available in all power modes of the RF transceiver module.

The embedded protocol engine (Enhanced ShockBurst™) enables data packet communication and supports various modes from manual operation to advanced autonomous protocol operation. Data FIFOs in the RF transceiver module ensure a smooth data flow between the RF transceiver module and the nRF24LE1 OTP MCU.

The rest of this chapter is written in the context of the RF transceiver module as the core and the rest of the nRF24LE1 OTP as external circuitry to this module.

3.1 Features

Features of the RF transceiver include:

- General
  - Worldwide 2.4 GHz ISM band operation
  - Common antenna interface in transmit and receive
  - GFSK modulation
  - 250 kbps, 1 and 2 Mbps on air data rate
- Transmitter
  - Programmable output power: 0, -6, -12 or -18dBm
  - 11.1mA at 0dBm output power
- Receiver
  - Integrated channel filters
  - 13.3mA at 2 Mbps
  - -82 dBm sensitivity at 2 Mbps
  - -85 dBm sensitivity at 1 Mbps
  - -94 dBm sensitivity at 250 kbps
- RF Synthesizer
  - Fully integrated synthesizer
  - 1 MHz frequency programming resolution
  - Accepts low cost ±60ppm 16 MHz crystal
  - 1 MHz non-overlapping channel spacing at 1 Mbps
  - 2 MHz non-overlapping channel spacing at 2 Mbps
- Enhanced ShockBurst™
  - 1 to 32 bytes dynamic payload length
  - Automatic packet handling (assembly/disassembly)
  - Automatic packet transaction handling (auto ACK, auto retransmit)
- 6 data pipe MultiCeiver™ for 6:1 star networks