1 General Product Information

1.1 Product Function and Intended Use

The equipment under test (EUT) is a Bluetooth Wireless PS3 controller operating at 2.4GHz

FCC ID

Model	Product description
RF-GPS3101	Wireless PS3 controller

1.2 Circuit Description

General

After turning the controller on, the STLC2500D module inside attempts to establish a two way radio link with another device using the Bluetooth protocol. The channel established is used to exchange data with a remote host. Bluetooth is a frequency hopping modulation scheme, which hops in a pseudorandom fashion every 625uS over 79 equally spaced channels (1MHz apart) in the range 2402MHz to 2480 MHz. It uses the GFSK (Gaussian Frequency Shift Keyed) modulation technique. Bluetooth is a widely recognized standard for communication in the 2.4GHz ISM band. The control signals and data in the Bluetooth Chipset are modulated and processed and then pass the PA in it. They will be transmitted from ANT through the BALUN FILTER to another Bluetooth device. The RF signal from other Bluetooth devices is received via ANT. And they go through internal BALUN FILTER into the chip. They are magnified by internal LNA in the chip.

There is a special mechanism which takes places using USB that is used to “pair” a controller with another device – settings for this are stored in the internal flash of STM32F103R6 device.

Co-ordination of the hopping sequence in data mode to avoid simultaneous occupancy by multiple transmitters:

Bluetooth units which want to communicate with other units must be organized in a structure called piconet. This piconet consist of max. 8 Bluetooth units. One unit is the master the other seven are the slaves. The master co-ordinates frequency occupation in this piconet for all units. As the master hop sequence is derived from it’s BD address which is unique for every Bluetooth device, additional masters intending to establish new piconets will always use different hop sequences.

Example of a hopping sequence in data mode:

Example of a 79 hopping sequence in data mode:

40, 21, 44, 23, 42, 53, 46, 55, 48, 33, 52, 35, 50, 65, 54, 67, 56, 37, 60, 39, 58, 69, 62, 71, 64, 25, 68, 27, 66, 57, 70, 59, 72, 29, 76, 31, 74, 61, 78, 63, 01, 41, 05, 43, 03, 73, 07, 75, 09, 45, 13, 47, 11, 77, 15, 00, 64, 49, 66, 53, 68, 02, 70, 06, 01, 51, 03, 55, 05, 04

Equally average use of frequencies in data mode and short transmissions:

The generation of the hopping sequence in connection mode depends essentially on two input values:

1. LAP/UAP of the master of the connection
2. Internal master clock

The LAP (lower address part) are the 24 LSB's of the 48 BD_ADDRESS. The BD_ADDRESS is an unambiguous number of every Bluetooth unit. The UAP (upper address part) are the 24 MSB's of the 48 BD_ADDRESS. The internal clock of a Bluetooth unit is derived from a free running clock which is never adjusted and is never turned off. For synchronization with other units, only the offsets are used. It has no relation to the time of the day. Its resolution is at least half the RX/TX slot length of 312.5 µs. The clock has a cycle of about one day (23h30). In most case it is implemented as 28 bit counter. For the deriving of the hopping sequence the entire LAP (24 bits), 4 LSB's (4 bits) (Input 1) and the 27 MSB's of the clock (Input 2) are used. With this input values different mathematical procedures (permutations, additions, XOR-operations) are performed to generate the sequence. This will be done at the beginning of every new transmission.

Regarding short transmissions, the Bluetooth system has the following behavior: The first connection between the two devices is established, a hopping sequence is generated. For transmitting the wanted data, the complete hopping sequence is not used and the connection ends. The second connection will be established. A new hopping sequence is generated. Due to the fact that the Bluetooth clock has a different value, because the period between the two transmission is longer (and it cannot be shorter) than the minimum resolution of the clock (312.5 µs). The hopping sequence will always differ from the first one.

Receiver input bandwidth, synchronization and repeated single or multiple packets:

The input bandwidth of the receiver is 1 MHz. In every connection, one Bluetooth device is the master and the other one is the slave. The master determines the hopping sequence (see chapter 5). The slave follows this sequence. Both devices shift between RX and TX time slot according to the clock of the master. Additionally the type of connection (e.g. single or multi-slot packet) is set up at the beginning of the connection. The master adapts its hopping frequency and its TX/RX timing is according to the packet type of the connection. Also, the slave of the connection uses these settings. Repeating of a packet has no influence on the hopping sequence. The hopping sequence generated by the master of the connection will be followed in any case. That means, a repeated packet will not be send on the same frequency, it is send on the next frequency of the hopping sequence.

Data exchange with other module:

Once a two-way radio link is activated, the remote device will exchange data with the STLC2500D. This communicates data using the Bluetooth HCI protocol to the STM32F103R6 device, which implements the higher levels of the Bluetooth protocol.

The STM32F103R6 reads the states of various analog inputs, and reports these in a periodic manner using the Bluetooth "Human Interface Device" protocol. Data exchanged includes button states, battery voltage, and other status information.

1.3 Ratings and System Details

	Receiver
Frequent Range:	2402-2480Mhz
Crystal Tolerance:	+/- 20ppm
Number of channels	79
Type of antenna	Inverted F
Protection Class	
Classification of device	