Operation description

Bluetooth USB Dongle: YBU-1200

1. **Purpose:** The purpose of this document is to describe key component operations on Bluetooth USB Dongle.

2. **Key components:** CSR BlueCore2-External (BC212015B) Bluetooth Single Chip, ST (M29W800AB) Flash Memory, Torex XC6204 series (XC6204B182MR, XC6204B332MR) High Speed LDO Regulators.

3. **Operation Principle:** CSR BlueCore2-External (BC212015B) is a single chip radio and baseband IC for Bluetooth 2.4GHz systems. It is implemented in 0.18µm CMOS technology. When used with external flash containing the CSR Bluetooth software stack, it provides a fully compliant Bluetooth system for data and audio communications.
   Operation at 2.7 ~ 3.3V supply.
   Operation clock is provided by 16MHz oscillator.

Key Features

Radio

-Operation with common TX/RX terminals simplifies external matching circuitry and eliminates external antenna switch
-Extensive built-in self-test minimizes production test time
-No external trimming is required in production

Transmitter

-Up to 0dBm RF transmit power with level control from the on-chip 6-bit DAC over a dynamic range greater than 30dB
-Supports Class 2 and Class 3 radios without the need for an external power amplifier or TX/RX switch

Receiver

-Integrated channel filters

-Digital demodulator for improved sensitivity and co-channel rejection
-Digitized RSSI available in real time over the HCI interface
-Fast AGC for enhanced dynamic range

Synthesizer
-Fully integrated synthesizer, no external VCO varactor diode or resonator
-Compatible with crystals between 8 and 32MHz (in multiples of 250KHz) or an external clock

Auxiliary Features
-Crystal oscillator with built-in digital trimming
-Power management includes digital shut down and wake up commands and an integrated low power oscillator for ultra-low Park/Sniff/Hold mode power consumption
-Devices can be used with an external Master oscillator and provides a 'clock request signal' to control external clock source.

Baseband and software
-External 8Mbit flash for complete system solution and application flexibility
-32kbyte on-chip RAM allows full speed Bluetooth data transfer, mixed voice and data, plus full 7 slaves piconet operation
-Dedicated logic for forward error correction, header error control, access code correlation, demodulation, cyclic redundancy check, encryption bit-stream generation, whitening and transmit pulse shaping
-Transcoders for A-law, μ-law and linear voice from host and A-law, μ-law and CVSD voice over air

Physical Interfaces
-Full speed USB interface supports OHCI and UHCI host interfaces. Compliant with USB v1.1
-Synchronous bi-directional serial programmable audio interface
-Operational I^2C^{TM} compatible interface

Bluetooth Stack Running on an Internal Micro-controller
CSR's Bluetooth Protocol Stack runs on-chip in a variety of configurations:
-Standard HCI (UART or USB)
-Fully embedded to RFCOMM, thus reducing host CPU load
-Package with 96 VFBGA 8x8x1.0 mm 0.65mm pitch.

ST (M29W800AB) 8Mbit Flash Memory

The ST (M29W800AB) is a 8Mbit low voltage single supply flash memory.

- 2.7V to 3.6V supply voltage for Program, Erase and Read operations
- Access time : 80ns
- Programming time : 10μs typical
- Program/Erase Controller: Program Byte-by-Byte or Word-by-Word, Status register bits and Ready/Busy output
- Security protection memory area
- Instruction address coding : 3 digits
- Memory blocks : boot block (top or bottom location), parameter and main blocks
- Block, multi-block and chip erase
- Multi block protection/temporary unprotection modes
- Erase suspend and resume modes : read and program another block during erase suspend
- Low power consumption : stand-by and automatic stand-by
- 100,000 program/erase cycles per block
- 20 years data retention : defectivity below 1 ppm/year

TOREX (XC6204series) High Speed LDO Regulators

The XC6204 series are highly precise, low noise, positive voltage LDO regulators manufactured using CMOS processes. The series achieves high ripple rejection and low dropout and consists of a voltage reference, an error amplifier, a current limiter and a phase compensation circuit plus a driver transistor. Output voltage is selectable in 50mV increments within a range of 1.8V ~ 6.0V. The series is also compatible with low ESR ceramic capacitors which give added output stability. This stability can be maintained even during load fluctuations due to the excellent transient response of the series.

The Current limiter's feedback circuit also operates as a short protect for the output current limiter and the output pin.

The CE function enables the output to be turned off, resulting in greatly reduced power consumption.

Features :

- Maximum Output Current: 150mA
- Dropout Voltage: 200mV (I_{OUT} = 100mA)
- Maximum Operating Voltage: 10V
- Output Voltage Range: 1.8V ~ 6.0V in 50mV increments

- Highly Accurate: ±2%
- Low Power Consumption: TYP 70μA
- Standby Current: less than 0.1μA
- High ripple Rejection: 70dB (10kHz)
- Low Output Noise: 30μVrms
- Operating Temperature Range: -40℃ ～+85℃
- Low ESR Capacitor Compatible: Ceramic capacitor

4 General Description of Bluetooth

Bluetooth is a short-range radio link intended to replace the cable(s) connecting portable and/or fixed electronic devices. Key features are robustness, low complexity, low power, and low cost.

Bluetooth operates in the unlicensed ISM band at 2.4 GHz. A frequency hop transceiver is applied to combat interference and fading. A shaped, binary FM modulation is applied to minimize transceiver complexity. The symbol rate is 1 Ms/s. A slotted channel is applied with a nominal slot length of 625 μs. For full duplex transmission, a Time-Division Duplex (TDD) scheme is used. On the channel, information is exchanged through packets. Each packet is transmitted on a different hop frequency. A packet nominally covers a single slot, but can be extended to cover up to five slots.The Bluetooth protocol uses a combination of circuit and packet switching.Slots can be reserved for synchronous packets. Bluetooth can support an asynchronous data channel, up to three simultaneous synchronous voice channels, or a channel which simultaneously supports asynchronous data and synchronous voice. Each voice channel supports a 64 kb/s synchronous (voice) channel in each direction. The asynchronous channel can support maximal 723.2 kb/s asymmetric (and still up to 57.6 kb/s in the return direction), or 433.9 kb/s symmetric. The Bluetooth system consists of a radio unit ,a link control unit, and a support unit for link management and host terminal interface

functions, see Figure 4.1

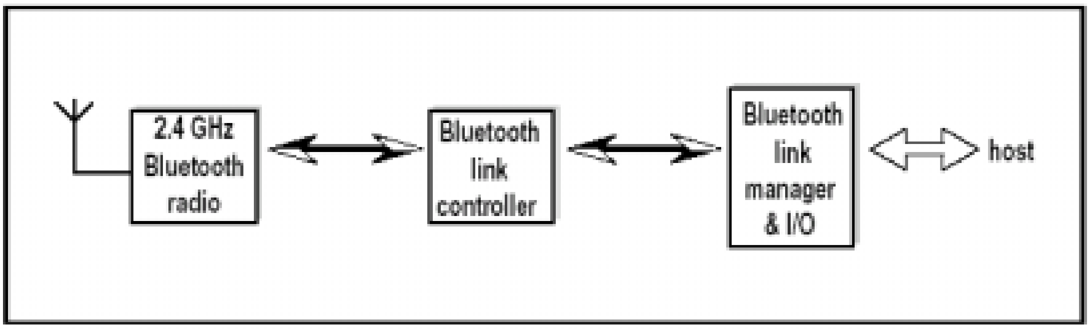

Figure 4.1

The current document describes the specifications of the Bluetooth link controller, which carries out the baseband protocols and other low-level link routines. Link layer messages for link set-up and control are defined in the Link Manager Protocol.

The Bluetooth system provides a point-to-point connection (only two Bluetooth units involved), or a point-to-multipoint connection.

In the point-to-multipoint connection, the channel is shared among several Bluetooth

units. Two or more units sharing the same channel form a ***piconet***. One Bluetooth unit acts as the master of the piconet, whereas the other unit(s)
acts as slave(s). Up to seven slaves can be active in the piconet. In addition, many more slaves can remain locked to the master in a so-called parked state. These parked slaves cannot be active on the channel, but remain synchronized to the master. Both for active and parked slaves, the channel access is controlled by the master. Multiple piconets with overlapping coverage areas form a ***scatternet***. Each piconet can only have a single master. However, slaves can participate in different piconets on a time-division multiplex basis. In addition, a master in one piconet can be a slave in another piconet. The piconets shall not be frequencysynchronized. Each piconet has its own hopping channel.

4.1 CHANNEL DEFINITION

The channel is represented by a pseudo-random hopping sequence hopping through the 79 or 23 RF channels. The hopping sequence is unique for the piconet and is determined by the Bluetooth device address of the master; the phase in the hopping sequence is determined by the Bluetooth clock of the master. The channel is divided into time slots where each slot corresponds to an RF hop frequency. Consecutive hops correspond to different RF hop frequencies. The nominal hop rate is 1600 hops/s. All Bluetooth units participating in the piconet are time- and hop-synchronized to the channel.
Here is a real example of the hopping sequence.

Pkt Num	M/S	Freq (MHz)	Master Clk	AM Addr	Pkt Type
0	M	2445	0x034a40a4	AM1	DM1
1	S	2406	0x034a40aa	AM1	DM1
2	M	2465	0x034a40d0	AM1	DM1
3	S	2466	0x034a40d6	AM1	DM1
4	M	2404	0x034a4104	AM1	DM1
5	S	2458	0x034a410a	AM1	DM1
6	S	2411	0x034a410e	AM1	DM1
7	M	2461	0x034a412c	AM1	DM1
8	M	2442	0x034a41d8	AM0	FHS
9	M	2463	0x0012eb20	AM1	DM1
10	M	2467	0x0012eb24	AM1	DM1
11	S	2434	0x0012eb76	AM1	DM1
12	S	2438	0x0012eb7a	AM1	DM1

13	M	2457	0x0012eb7c	AM1	DM1
14	S	2466	0x0012eb7e	AM1	DM1
15	M	2418	0x0012eb84	AM1	DM1
16	S	2411	0x0012ebd6	AM1	DM1
17	S	2413	0x0012ebda	AM1	DM1
18	M	2446	0x0012ebdc	AM1	DM1
19	M	2448	0x0012ebe0	AM1	DM1
20	S	2477	0x0012ec32	AM1	DM1

4.2 TIME SLOTS

The channel is divided into time slots, each 625 μs in length. The time slots are numbered according to the Bluetooth clock of the piconet master. The slot numbering ranges from 0 to 2^{27}-1 and is cyclic with a cycle length of 2^{27}. In the time slots, master and slave can transmit packets.

A TDD scheme is used where master and slave alternatively transmit, see Figure 4.2 The master shall start its transmission in evennumbered time slots only, and the slave shall start its transmission in oddnumbered time slots only. The packet start shall be aligned with the slot start. Packets transmitted by the master or the slave may extend over up to five time slots.

The RF hop frequency shall remain fixed for the duration of the packet. For a single packet, the RF hop frequency to be used is derived from the current Bluetooth clock value. For a multi-slot packet, the RF hop frequency to be used for the entire packet is derived from the Bluetooth clock value in the first slot of the packet. The RF hop frequency in the first slot after a multi-slot packet shall use the frequency as determined by the current Bluetooth clock value. Figure 4.3 illustrates the hop definition on single- and multi-slot packets. If a packet occupies more than one time slot, the hop frequency applied shall be the hop frequency as applied in the time slot where the packet transmission was started.

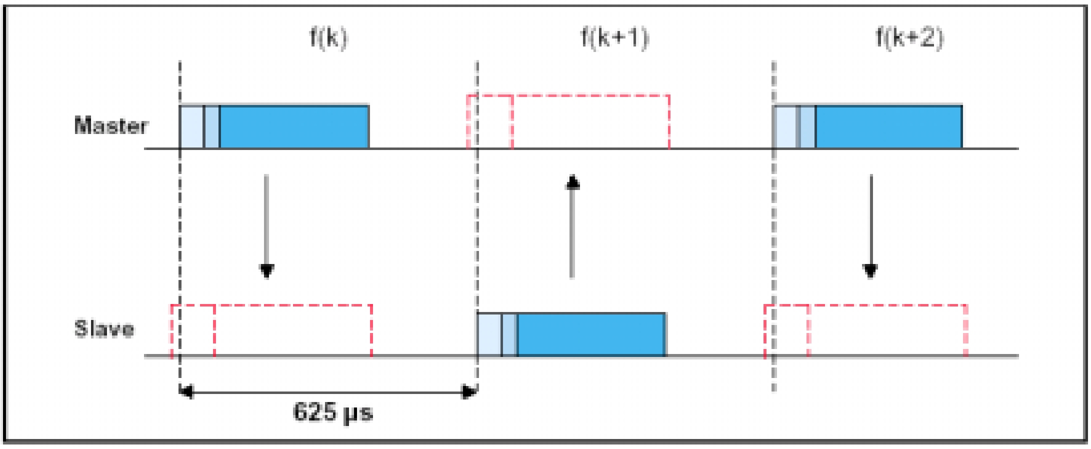

Fig 4.2

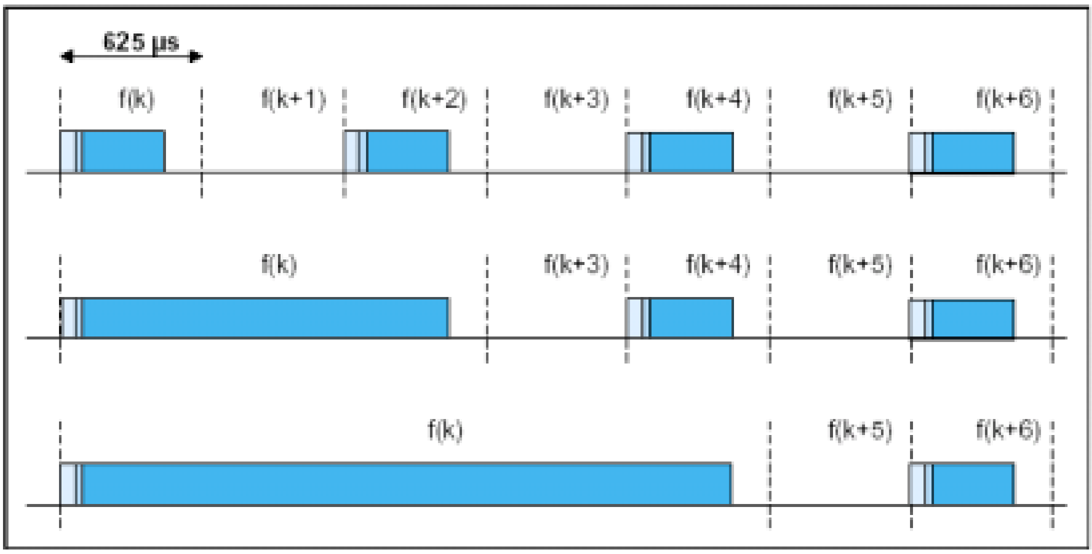

Fig 4.3