ALPS Bluetooth Transceiver Module, UGPZ series

Theory of Operation

Bluetooth is an open standard developed by four OEM's (Ericsson, Nokia, IBM, and Toshiba) and one semiconductor company (Intel). The standard aims to define a globally accepted short distance (10m/30ft) radio communication protocol using a part of the radio frequency that is unlicensed (i.e. free to use) in most parts of the world. Bluetooth's key characteristic is that enabled devices can detect and communicate with other enabled devices within range – all without conscious user intervention.

The ALPS Bluetooth transceiver module is a PWB type that plugs into motherboard of personal computer, PDA etc. It contains an interface that meets of the USB/UART. The module operates like an I/O device to the host processor. It also contains a radio transmitter and receiver that meets the requirements defined in the standards published by the Bluetooth Special Interest Group.

The combination of the module interface, radio, along with associated Bluetooth software stack, and application software provides a convenient way for the host platform to wirelessly interact with various devices such as mobile phones, printers, etc.

The radio part of the ALPS Bluetooth module is specified in the Bluetooth open standard. It operates in the frequency band of 2402 to 2480 Mhz at a radiated power level of 0.011 watt (typ.) for UGPZ1 and 0.001 watt (typ.) for UGPZ2. It radiates using Gaussian Frequency shift keying and uses frequency hopping spread spectrum on 79 equally spaced channels. All channels are 1 MHz apart and hop through the channels using a pseudo-random hopping sequence. The device hops from channel to channel at a rate of 1600 hops per second. The radio is completely controlled by the associated software stack and application program. The stack controls the hopping sequence, and protocols for establishing a connection with other Bluetooth devices in the near vicinity.

1. Derivation of the pseudorandom hopping sequence.

Hopping sequence selection for a system is controlled by the master unit within a specific system. The sequence is selected by a combination of address codes and master unit system clock.
The pseudo-random sequence is generated in a nine-stage shift register whose 5^{th} and 9^{th} stage outputs are added in a modulo-two addition stage with the result fed back to the input of the first stage.
This produces a pseudo-random sequence length of 31 bits for page and inquiry modes and provides for transition to a 511 bits pseudorandom sequence length for data mode of operation.
The following are two examples of possible 79 channel hopping sequences with channels identified as 1 through 79. The channel numbering scheme starts with channel 2 at 2402 MHz with the 79^{th} channel then appearing at 2480 MHz as channel 80.

Sequence a:
2,17,68,55,4,77,56,27,70,80,22,33,57,34,29,79,44,50,3,71,66,36,78,20,67,30,24,11,37,69,
23,7,41,38,63,14,31,59,40,13,6,25,65,15,61,73,58,47,19,28,54,76,74,48,52,75,5,42,64,72,

62,51,60,18,45,53,16,39,46,32,49,43,8,21,9,12,10,26,35

Sequence b:
50,6,41,57,64,14,42,33,79,3,20,38,56,69,75,21,80,23,31,40,45,68,32,28,4,15,34,59,71,61,
70,5,72,13,48,70,39,54,78,7,77,62,30,2,8,55,10,63,12,16,37,11,43,66,25,51,58,74,17,47,
9,29,65,19,53,18,52,36,27,26,44,22,49,24,35,60,73,76,67

2. Use of each frequency equally on average.
The FHS (frequency hop selection) packet is transmitted by a sending unit.
It contains UAP (upper address part)/LAP (lower address part) as well as clock information which is updated before retransmission in the inquiry state. When in hybrid substate, the UAP/LAP is used together with the clock to select the sequence. The output from the selection box constitutes a pseudo-random sequence covering 79 hops for US operation. For inquiry mode, the selection scheme chooses a segment of 32 hop frequencies from the 79 hops spanning about 64 MHz and visits these hops once in a random order. Next, a different 32-hop segment is chosen, etc. Refer to chapter 11 of the Bluetooth specification for a more through explanation of the hopping structure.

3. Receiver matching bandwidth and synchronization.
The receiver bandwidth is 1 MHz in the data mode. During connection establishment, the master identity and clock are transferred to the slave unit so it can synchronize to the channel.
The master clock in a slave unit is obtained by adding an offset to the internal clock of the slave. Also see above item 1 for details on the master clock and pseudo-random hopping channel selection.

4. Antenna.
RF energy is radiated from the module through an antenna (internal antenna) that is completely mounted onto the PWB of the module, or an external antenna that is connected by unique connector of the module.

5. More information.
The current BlueTooth specification version 1.1 is available to anyone at no cost from the BlueTooth SIG, Inc. website at http://www.bluetooth.com/ . The specification is in two sections, the CORE specification and the Profile specification. Both sections together are approximately 1500 pages.

Operation description:

1. Purpose:

The purpose of this document is to describe key component operations on Bluetooth.

The BTU** Series are the advanced USB Flash Disk (UFD) with Bluetooth communication system. (UFD is a developed mobile storage device. It stores data in flash memory ICs. UFD can be re-used for 100,000 times and data retention for 10 years. Transfer rate is 15 times faster than floppy disk. The UFD is an easy-to- use, reliable, security mobile mass storage device.)

2. Key components:

ALPS ELECTRIC CO., LTD. Bluetooth Module: UGPZ2-109A;

Alcor Micro Corp USB HUB: AU9254 and mass storage microprocessor

AU6680; K9FXXXXUOM, SAMSUNG Flash Memory,

Matsushita narrow-pitch 20 pin high reliability connectors

3. Operation Principle:

UGPZ2-109A, Bluetooth Module contains CSR BC2-EXT (BC212013/BC212015), which has complete radio part and base band controller section (16bits RISC processor, ram and flash memory).

Protocol software is already downloaded into integrated Flash memory and interfaces to HCI layer of upper layer protocol stack on an appropriate host system. It provides a fully compliant Bluetooth system for data and voice communications.

USB flash disk function resort to mass storage micro processor

AU6680 via USB HUB: AU9254 transmit data with PC

Operation at 2.7 ~ 3.3V supply.

Operation clock is provided by 12MHz oscillator.

4. Key Features:

. Supports huge capacity (16MB/32MB/64MB/128MB/256MB)

. USB1.0/1.1 compliant, supporting plug-and-play.

. No auxiliary power supply necessary, powered by USB bus directly.

. Built-in write protection switch protect data from delete and virus attack.

. Read speed: 1.1 MB/S

. Write speed: 700KB/s

. Data can be preserved more than 10 years

. Storage media: Flash Memory

. Compact size

. Two modules, UFD module and Bluetooth module combine the BTU* series products.

. The Bluetooth module in this product is a standard Bluetooth System, which comply with Bluetooth Specification Version 1.1;

. No driver necessary for UFD in Windows Me/2000/XP, Mac OS9, Linux Kernel 2.4x Operating System.

. A special application software for Bluetooth system, which used to drive and manage the Bluetooth devices.

. Supports “portable QQ” functions via a special application program (Optional).

. Supports USB Flash Disk bootable function if the motherboard supports booting from USB devices (Optional item).

5. Electrical Specifications:

Fully compliant with USB 1.1 specification and UHCI, OHCI standards

Data transfer-rate:

Read: 1.1 Megabytes per second approximately.

Write: 700 Kilobytes per second approximately.

Power Supply: UFD is powered by USB bus directly, the power should be within 4.75V, 500mA to 5.25V, 500mA.

Fully compatible with Windows98 (A driver is required).

Fully compatible with Windows Me, Windows2000, Windows XP, Linux kernel 2.4 and the driver is needless.

Power consumption: less than 0.5Watt.

6. Physical Layer specifications:

Common Physical Layer Specifications

Operating Frequency	2402 MHz to 2480 MHz
Carrier Spacing	1.0 MHz
Channel	79
Duplexing	TDD
Symbol Rate	1 Mbps
Modulation Method	GFSK BbT = 0.5
Reference Oscillator	16MHz (built in)
RF input and output impedance	Nominal 50 ohm

7. Tx Specifications:

TX Specifications (UGPZ2 / Class2)

Items	Spec. limits			Unit	Conditions	
	Min	Typ	Max		Temp.	Volt.
Normal Transmit Power Averaged power	-6	0	+4	dBm	Extreme	Extreme
Maximum controlled level	-6	0	+4	dBm	Nominal	Nominal
Minimum controlled level			-6	dBm	Nominal	Nominal
Power control step size	2		8	dB	Nominal	Nominal
Radio Frequency Tolerance	-75		+75	kHz	Extreme	Extreme
Radio Frequency drift One slot Three slot Five slot Drift Rate	 -25 -40 -40 -20		 +25 +40 +40 +20	 kHz kHz kHz kHz/50μs	Extreme	Extreme
Peak Deviation 00001111($df1_{avg}$) 01010101($df2_{min}$) 01010101($df2_{avg}/df1_{avg}$)	 ±140 ±115 80		 ±175	 KHz KHz %	Extreme	Extreme
Spurious Emission(In Band) *1) ±500 kHz |M-N| = 2 *2)|M-N| ≥ 3	 -20		 -20 -40	 DBc DBm DBm	Extreme	Extreme
Spurious Emission(out of Band) *3) 30 MHz ~ 1 GHz 1 GHz ~ 12.75 GHz 1.8 GHz ~ 1.9 GHz 5.15 GHz ~ 5.3 GHz			 -36 -30 -47 -47	 DBm dBm dBm dBm	Extreme	Extreme
TX current consumption *4)		65	80	mA	Nominal	Nominal

RX Specifications

Items	Spec limits			Unit	Conditions	
	Min	Typ	Max		Temp.	Volt.
Reference Sensitivity Level (BER=0.001)		-78	-70 TBD	dBm	Extreme Nominal	Extreme Nominal
Reference Interference Level *1) BER<=0.1% Co-ch interference C/I_{co} Adj. (1 MHz) interference C/I_{1MHz} Adj. (2 MHz) interference C/I_{2MHz} Adj. (≥3 MHz) interference C/I_{3MHz} Image Ch interference C/I_{Image} Image Ch interference $C/I_{Image±1MHz}$	 11 0 -30 -40 -9 -20			 dB dB dB dB dB dB	 Nominal	 Nominal
Out of Band Blocking *2) BER ≤0.1 % 30 MHz ~ 2 GHz 2 GHz ~ 2.4 GHz 2.5 GHz ~ 3 GHz 3 GHz ~ 12.75 GHz	 -10 -27 -27 -10			 dBm dBm dBm dBm	 Nominal	 Nominal
Intermodulation Characteristics *3) BER ≤ 0.1% Carrier Level: -64 dBm	-39			dBm	Nominal	Nominal
Maximum Usable Level	-20			dBm	Nominal	Nominal
Spurious Emission 30 MHz ~ 1 GHz 1 GHz ~ 12.75 GHz			 -57 -47	 dBm dBm	Nominal	Nominal
RX current consumption		65	80	mA	Nominal	Nominal