APPENDIX K
GINGER SPECIFICATIONS

1 GENERAL

1-1 Purpose and Scope of this document

This document contains the specifications pertinent to the module for Bluetooth™ system, which comply with BLUETOOTH™ Specifications Version 1.1.

This document specifies and describes General, Mechanical, Electrical, Software and Reliability specifications and aspects for ALPS Bluetooth™ Module ver2.

1-2 Product Overview

ALPS Bluetooth™ Module contains complete radio part and base band controller section (16bits RISC processor, RAM and Flash memory). Also, high accuracy reference oscillator and sub clock for extremely low power management are built in. Protocol software is already downloaded into integrated Flash memory and interfaces to HCI layer of upper layer protocol stack on an appropriate host system.

ALPS Bluetooth™ Module permits standard operating conditions according to the following table and will perform typical features described on the second table.

1-2-1 Standard Operating Conditions

Items	Conditions
Operating Temperature	Nominal: +15 °C to +35 °C Extreme: -20°C to +75 °C
Operable Temperature	-20°C to +75 °C
Storage Temperature	-30 °C to +85 °C
Supply Voltage ; VCC	Nominal: +3.3 V Extreme: +3.3 V ± 0.1 V
Absolute Maximum Ratings Supply Voltage	VCC : -0.4V ~ +3.6V

1-2-2 Features List

Features	Contents
Power level	+20 dBm Max.
Program memory	4M bits (256k bytes x 16 bits) Flash
RAM	32k bytes x 16 bits
Reference oscillator	Built in
Sub clock oscillator	Built in
Audio interface	PCM A-Law, μ-Law (CVSD)
USB interface	USB (v1.1 : OHCI and UHCI)
Physical connection	SMD (solder ball bump array)

1-3 Radio part

Bluetooth™ Module has fully integrated 2.4GHz radio transceiver with Class1 power amplifier, receiver and frequency-hopping synthesizer. In order to facilitate power management, each section of the radio may be powered up and down separately. Various software controllable switches have been implemented to control power to the transmitter, the frequency synthesizer/VCO, the receiver and the LNA.

1-4 Base band part

Bluetooth™ Module contains link controller, which performs all the real-time functions of the Bluetooth™ baseband protocol layer, including data transfer and connection management. The device also controls states of operation enables sniff, park and hold modes of operation. Real-time functions such as frequency-hopping burst timing and clock synchronization are also implemented in this hardware. Further processing is required to format the data into the Bluetooth™ packet format before it may be applied to the GFSK modulator. On the receive side the controller performs error correction and de-scrambling before de-packetizing the incoming payload and storing it in RX buffers.

The link controller hardware also implements the basic, repetitive actions of paging, inquiry, page or inquiry scans and the general Bluetooth™ modes of park and sniff. This ensures that the processor used to implement the Link Manager and other lower layer protocol can be kept inactive. Also base band contains the following functionality.

1-4-1 FEC – Forward Error Correction

FEC provides the ability to correct any errors, which might have occurred during the transmission of the original data. FEC rate of 1/3, 2/3, and Automatic Repeat Request (ARQ) are implemented.

1-4-2 Whiten / De-whiten – Scramble/Unscramble

Whitening/Scramble refers to the addition of randomized data to avoid any undesirable DC bias effects in the transfer of data packets. De-whitening/Unscramble is the reversal of the original process where the original data can be extracted.

1-4-3 Encrypt/Decrypt – Apply/Remove Encryption

Encryption is the security feature where keys are used to prevent the access of data to unauthorized sources. This functional block is responsible for the processing of authentication and key management functions required by Bluetooth™

1-4-4 CRC – Cyclic Redundancy Check

This is the error detection function implemented to process the CRC field within the payload section of a Bluetooth™ transfer packet. On the receive side, the CRC is checked with the expected value based on

algorithms. On the transmit, and proper CRC is generated to and appended to the payload.

1-4-5 HEC – Header Error Correction

This is the error correction function implemented dealing with the 8-bit HEC field of the Bluetooth™ packet header as specified in Version 1.1 spec.

1-5 Attention for FAA (Federal Aviation Association) compliance

FAA proposal is to restrict use of any wireless devices during entire flight. This restriction is applied for also Bluetooth™ as well. Customer must implements disable switch of Bluetooth™ functionality by hardware or software. Module contains disable and enable radio over extended HCI commands, which shall be implemented into application software for any products, which might be carried out to airplane.

1-6 LIFE SUPPORT APPLICATIONS

This product is not designed for use in life support appliances, devices or systems where malfunction of this product can reasonably be expected to result in personal injury. ALPS customers using or selling this product for use in such applications do so at their own risk and agree to fully indemnify ALPS for any damages resulting from such improper use or sale.

2 RADIO PART (RF) SPECIFICATIONS

All RF specification items below are specified in accordance with Bluetooth™ RF Test Specification Revision 0.91 dated on 2001-Jul-02 and corresponding Critical Erratum.

2-1 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

2-2 TX Specifications

Items	Spec. limits			Unit	Conditions	
	Min	Typ	Max		Temp.	Volt.
Normal Transmit Power						
Peak power	0	12.5	23.0	dBm	Extreme	Extreme
Averaged power	0	12.0	20.0			
Maximum controlled level	9.0	12.0	15.0	dBm	Nominal	Nominal
Minimum controlled level			4.0	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	-25		+25	kHz	Extreme	Extreme
Three slot	-40		+40	kHz		
Five slot	-40		+40	kHz		
Drift Rate	-20		+20	kHz/50μs		
Peak Deviation						
00001111($df1_{avg}$)	±140		±175	kHz	Extreme	Extreme
01010101($df2_{min}$)	±115			kHz		
01010101($df2_{avg}/df1_{avg}$)	80			%		
Spurious Emission(In Band) *1)						
±500 kHz	-20			dBc	Extreme	Extreme
|M-N| = 2			-20	dBm		
|M-N| ≥ 3			-40	dBm		
Spurious Emission(out of Band) *2)						
30 MHz ~ 1 GHz			-36	dBm	Extreme	Extreme
1 GHz ~ 12.75 GHz			-30	dBm		
1.8 GHz ~ 1.9 GHz			-47	dBm		
5.15 GHz ~ 5.3 GHz			-47	dBm		
TX current consumption *3)		200	220	mA	Nominal	Nominal

Notes:

*1) The transmit power shall be measured in the following conditions.

Frequency offset	Test Condition
± 500 kHz	RBW: 10 kHz, VBW: 30 kHz
|M-N| = 2	RBW: 100 kHz, VBW: 300 kHz
|M-N| ≥ 3	RBW: 100 kHz, VBW: 300 kHz

M : Transmit channel, N : Measured channel

*2) The transmit power shall be measured in a 100 kHz bandwidth.

*3) Based on Normal Transmit Power specified on the above table.

2-3 RX Specifications

Items	Spec limits			Unit	Conditions	
	Min	Typ	Max		Temp.	Volt.
Reference Sensitivity Level (BER=0.001)		-78	-70	dBm	Extreme	Extreme
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		60	75	mA	Nominal	Nominal

Note *1) Carrier Signal Level: -67 dBm (Adj.(≥3 MHz), Image)

Carrier Signal Level: -60 dBm (Co-chi, Adj.(1 MHz), Adj.(2 MHz)) Frequencies where the requirements are not met are called spurious response frequencies. Five spurious response frequencies with a distance of ≥2 MHz from the wanted signals are allowed. On these spurious response frequencies a relaxed interference requirement C/I = -17 dB must be met.

Note *2) Carrier Signal level: -67 dBm

24 exceptions are permitted which are dependent upon the given receive channel frequency and are centered at a frequency which is an integer multiple of 1 MHz. At 19 of those spurious response frequencies a relaxed power level –50 dBm of the interfere may used to achieve a BER of 0.1 % and at the remaining 5 spurious response frequencies the power level is arbitrary.

Note *3) Carrier signal level: -64 dBm

A static sine wave signal at f1 with a power level of –39 dBm. A Bluetooth™ module signal at f2 with a power level of –39 dBm. Such that f0 = 2f1 –f2 and f2 –f1 = n*1 MHz, where n can be 3, 4 or 5. The system must fulfill one of there alternatives.

REFERENCE INTERFERENCE SIGNAL DEFINITION

A modulated Interfering signal is defined as: Modulation = GFSK
Modulation index = 0.32 ±1 %
BT = 0.5 ±1 %
Bit rate 1Mbps ±1 ppm
Modulating data = PRBS9
Frequency Accuracy better than ±1 ppm