



ภาคผนวก

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่

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ภาคผนวก ก

ผลการทำนาย ณ ห้องเรียนสำหรับกรณีคนยืนอยู่ที่ 1 เมตรในช่วงเวลาต่างๆ

		Predicted Class (8AM)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	92.50
	C2	0	19	1	0	
	C3	1	0	18	1	
	C4	0	2	1	17	

		Predicted Class (10AM)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	95.00
	C2	0	20	0	0	
	C3	0	0	19	1	
	C4	0	2	1	17	

		Predicted Class (12PM)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	93.75
	C2	0	19	1	0	
	C3	0	0	19	1	
	C4	0	3	0	17	

		Predicted Class (2PM)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	87.50
	C2	0	18	0	2	
	C3	0	0	18	2	
	C4	0	3	3	14	

		Predicted Class (4PM)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	87.50
	C2	0	20	0	0	
	C3	0	0	18	2	
	C4	0	4	4	12	

ผลการทำนาย ณ ห้องเรียนสำหรับกรณีคนยืนอยู่ที่ 2 เมตรในช่วงเวลาต่างๆ

		Predicted Class (8AM)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	19	0	1	0	90.00
	C2	0	20	0	0	
	C3	3	1	16	0	
	C4	0	3	0	17	

		Predicted Class (10AM)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	19	0	1	0	93.75
	C2	0	20	0	0	
	C3	0	1	19	0	
	C4	0	4	0	17	

		Predicted Class (12PM)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	95.00
	C2	0	20	0	0	
	C3	0	1	19	0	
	C4	0	3	0	17	

		Predicted Class (2PM)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	90.00
	C2	0	19	1	0	
	C3	0	1	19	0	
	C4	0	6	0	14	

		Predicted Class (4PM)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	90.00
	C2	0	20	0	0	
	C3	0	1	19	0	
	C4	0	7	0	13	

ผลการทำนาย ณ ห้องเรียนสำหรับกรณีคนยืนอยู่ที่ 2.5 เมตรในช่วงเวลาต่างๆ

		Predicted Class (8AM)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	90
	C2	0	20	0	0	
	C3	0	4	15	1	
	C4	0	2	1	17	

		Predicted Class (10AM)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	95
	C2	0	20	0	0	
	C3	0	0	20	0	
	C4	0	3	1	16	

		Predicted Class (12PM)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	96.25
	C2	0	20	0	0	
	C3	0	0	20	0	
	C4	0	3	0	17	

		Predicted Class (2PM)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	90
	C2	0	20	0	0	
	C3	0	0	19	1	
	C4	0	3	4	13	

		Predicted Class (4PM)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	90
	C2	0	20	0	0	
	C3	0	1	19	0	
	C4	0	6	1	13	

ผลการทำนาย ณ ห้องเรียนสำหรับกรณีคนยืนอยู่ที่ 3 เมตรในช่วงเวลาต่างๆ

		Predicted Class (8AM)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	19	0	1	0	92.50
	C2	0	19	0	1	
	C3	0	0	20	0	
	C4	0	4	0	16	

		Predicted Class (10AM)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	96.25
	C2	0	20	0	0	
	C3	0	0	20	0	
	C4	0	3	0	17	

		Predicted Class (12PM)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	95.00
	C2	0	20	0	0	
	C3	0	0	19	1	
	C4	0	3	0	17	

		Predicted Class (2PM)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	88.75
	C2	0	20	0	0	
	C3	0	0	19	1	
	C4	0	8	0	12	

		Predicted Class (4PM)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	90.00
	C2	0	19	1	0	
	C3	0	0	20	0	
	C4	0	7	0	13	

ผลการทำนาย ณ ห้องเรียนสำหรับกรณีคนยืนอยู่ที่ 4 เมตรในช่วงเวลาต่างๆ

		Predicted Class (8AM)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	96.25
	C2	0	20	0	0	
	C3	0	0	20	0	
	C4	0	3	0	17	

		Predicted Class (10AM)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	96.25
	C2	0	20	0	0	
	C3	0	0	20	0	
	C4	0	3	0	17	

		Predicted Class (12PM)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	96.25
	C2	0	20	0	0	
	C3	0	0	20	0	
	C4	0	3	0	17	

		Predicted Class (2PM)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	92.50
	C2	0	20	0	0	
	C3	0	0	20	0	
	C4	0	6	0	14	

		Predicted Class (4PM)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	91.25
	C2	0	20	0	0	
	C3	0	0	20	0	
	C4	0	6	1	13	

ภาคผนวก ข

ผลการทำนายจากการเปลี่ยนระยะห่าง Tx-Rx ต่างๆ ณ ระยะเบี่ยงทางเดินในอาคาร

		Predicted Class (5m)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	91.25
	C2	0	20	0	0	
	C3	0	0	19	1	
	C4	0	4	2	14	

		Predicted Class (10m)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	90.00
	C2	0	20	0	0	
	C3	0	0	20	0	
	C4	0	7	1	12	

		Predicted Class (15m)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	19	1	0	0	81.25
	C2	0	20	0	0	
	C3	0	11	9	0	
	C4	0	1	2	17	

		Predicted Class (20m)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	17	0	3	0	68.75
	C2	0	18	0	2	
	C3	6	4	10	0	
	C4	0	7	3	10	

ผลการทำนายจากการเปลี่ยนระยะห่าง Tx-Rx ต่างๆ ณ สถานกิจกรรมในร่ม

		Predicted Class (5m)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	90.00
	C2	0	20	0	0	
	C3	0	0	19	1	
	C4	0	1	6	13	

		Predicted Class (10m)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	83.75
	C2	0	20	0	0	
	C3	0	5	14	1	
	C4	0	2	5	13	

		Predicted Class (15m)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	77.50
	C2	0	20	0	0	
	C3	0	8	8	4	
	C4	0	5	1	14	

		Predicted Class (20m)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	15	2	3	0	63.75
	C2	0	17	3	0	
	C3	5	4	7	4	
	C4	0	4	4	12	

ภาคผนวก ค

ผลการทำนายกรณีมีกระดานตั้งอยู่จุด A

		Predicted Class(Lab1)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	87.50
	C2	0	19	0	1	
	C3	0	2	18	0	
	C4	0	4	3	13	

		Predicted Class(Lab2)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	19	0	1	0	88.75
	C2	0	20	0	0	
	C3	2	0	18	0	
	C4	0	3	3	14	

ผลการทำนายกรณีมีกระดานตั้งอยู่จุด C

		Predicted Class(Lab1)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	81.25
	C2	0	15	5	0	
	C3	0	3	17	0	
	C4	0	2	5	13	

		Predicted Class(Lab2)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	82.50
	C2	0	19	0	1	
	C3	1	0	13	2	
	C4	0	6	2	14	

ภาคผนวก ง

ผลการทำนายกรณีเปลี่ยนบุคคลดำเนินการ

		Predicted Class(Lab1)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	88.75
	C2	0	19	0	1	
	C3	0	1	19	0	
	C4	0	6	0	13	

		Predicted Class(Lab2)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	88.75
	C2	0	20	0	0	
	C3	0	2	18	0	
	C4	0	5	0	13	

ภาคผนวก จ

ผลการทำนายกรณีใช้โปรแกรม AP อื่น

		Predicted Class(Lab1)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	88.75
	C2	0	19	1	0	
	C3	0	0	19	1	
	C4	0	4	3	13	

		Predicted Class(Lab2)				Accuracy (%)
		C1	C2	C3	C4	
Actual Class	C1	20	0	0	0	92.50
	C2	0	18	0	2	
	C3	0	0	20	0	
	C4	0	3	1	16	

ภาคผนวก จ

ลักษณะและคุณสมบัติอุปกรณ์ที่ใช้ในการทดลอง



D-Link *AirPilus*™ G DI-524

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SPECIFICATIONS

Standards

- IEEE 802.11g
- IEEE 802.11b
- IEEE 802.3
- IEEE 802.3u

Data Rates¹

With Automatic Fallback

- | | | |
|-----------|----------|----------|
| • 54Mbps | • 48Mbps | • 36Mbps |
| • 24Mbps | • 18Mbps | • 12Mbps |
| • 11Mbps | • 9Mbps | • 6Mbps |
| • 5.5Mbps | • 2Mbps | • 1Mbps |

Security

- 802.1x
- 64-, 128-WEP
- WPA — Wi-Fi Protected Access (WEP with TKIP, MIC, IV Expansion, Shared Key Authentication)

Modulation Technology

Orthogonal Frequency Division Multiplexing (OFDM)

Receiver Sensitivity

- 54Mbps OFDM, 10% PER, -68dBm)
- 48Mbps OFDM, 10% PER, -68dBm)
- 36Mbps OFDM, 10% PER, -75dBm)
- 24Mbps OFDM, 10% PER, -79dBm)
- 18Mbps OFDM, 10% PER, -82dBm)
- 12Mbps OFDM, 10% PER, -84dBm)
- 11Mbps CCK, 8% PER, -82dBm)
- 9Mbps OFDM, 10% PER, -87dBm)
- 6Mbps OFDM, 10% PER, -88dBm)
- 5.5Mbps CCK, 8% PER, -85dBm)
- 2Mbps QPSK, 8% PER, -86dBm)
- 1Mbps BPSK, 8% PER, -89dBm)

VPN Pass Through/ Multi-Sessions

- | | | |
|--------|--------|---------|
| • PPTP | • L2TP | • IPSec |
|--------|--------|---------|

Device Management

- Web-based Internet Explorer v6 or later; Netscape Navigator v6 or later; or other Java-enabled browsers
- DHCP Server and Client

Wireless Frequency Range

2.4GHz to 2.462GHz

Wireless Operating Range²

- Indoors - up to 328 ft. (100 meters)
- Outdoors- up to 1312 ft. (400 meters)

Wireless Transmit Power

15dBm $\pm$ 2dBm

External Antenna Type

Single detachable reverse SMA

Advanced Firewall Features

- NAT with VPN Pass-through (Network Address Translation)
- MAC Filtering
- IP Filtering
- URL Filtering
- Domain Blocking
- Scheduling

Operating Temperature

32°F to 131°F (0°C to 55°C)

Humidity

95% maximum (non-condensing)

Safety and Emissions:

FCC

LEDs

- Power
- Status
- WAN
- WLAN (Wireless Connection)
- LAN (10/100)

Dimensions

- L = 5.6 (142mm)
- W = 4.3 (109mm)
- H = 1.2 inches (31mm)

Weight

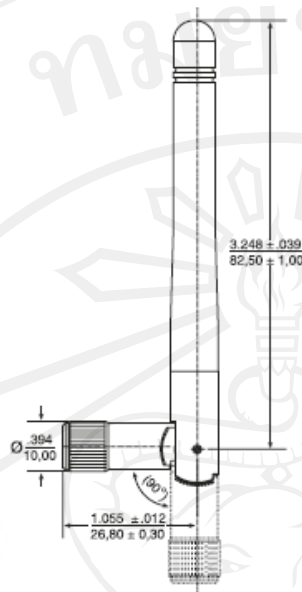
7.8 oz (0.22kg)

Warranty

3 Year

¹ Maximum wireless signal rate based on IEEE Standard 802.11g specifications. Actual data throughput will vary. Network conditions and environmental factors, including volume of network traffic, building materials and construction, and network overhead lower actual data throughput rate.

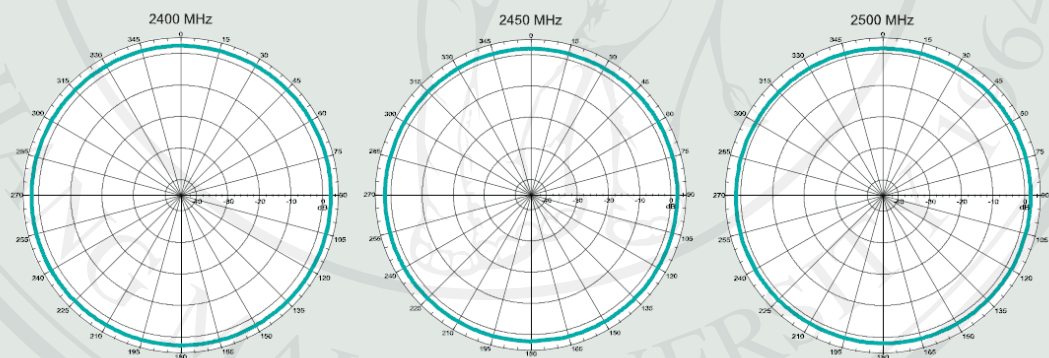
² Environmental factors may affect actual range.



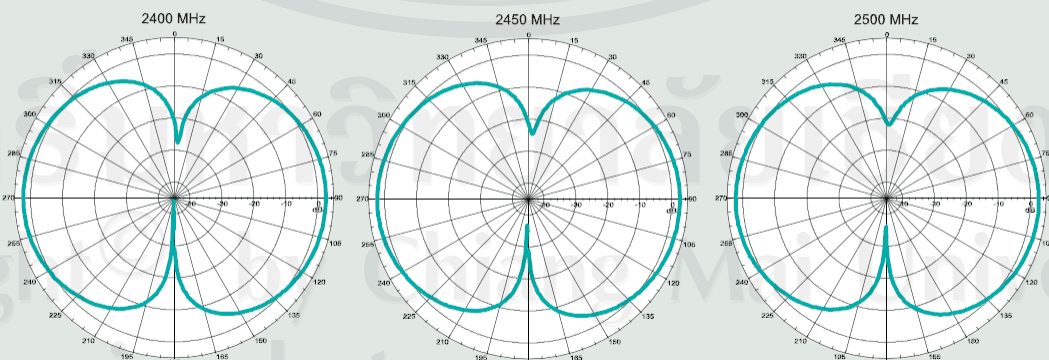
- Weight : 63 grams
- Dimensions : $\frac{\text{Inches}}{\text{mm}}$
- Unless otherwise specified, all tolerances are $\pm \frac{.010}{0.25}$
- Frequency : 2.4 – 2.5 GHz
- Gain : 2 dBi
- Impedance : 50 Ω
- Electrical length : 1/4 , dipole
- Radiation : Omni

Gain Performance

Horizontal Position



Vertical Position





LINKSYS by Cisco

Specifications

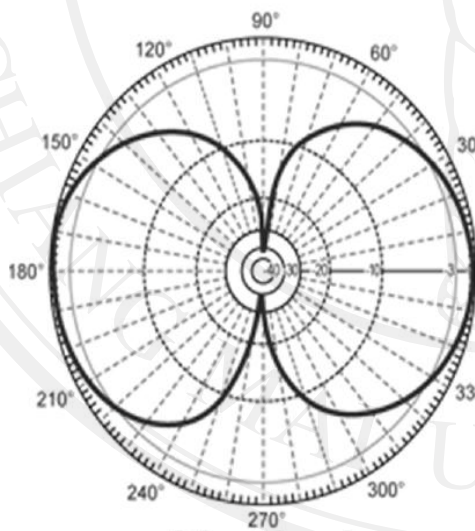
Model	WRT54GL
Standards	IEEE 802.3, IEEE 802.3u, IEEE 802.11g, IEEE 802.11b
Ports	Internet: One 10/100 RJ-45 Port Ethernet: Four 10/100 RJ-45 Switched Ports One Power Port
Buttons	One Reset Button
LEDs	Power, DMZ, WLAN, Ethernet (1, 2, 3, 4), Internet
Cabling Type	CAT 5
RF Power (EIRP) in dBm	18
UPnP able/cert	Able
Security Features	Stateful Packet Inspection (SPI) Firewall, Internet Policy
Wireless Security	Wi-Fi Protected Access™ 2 (WPA2), WEP, Wireless MAC Filtering

Environmental

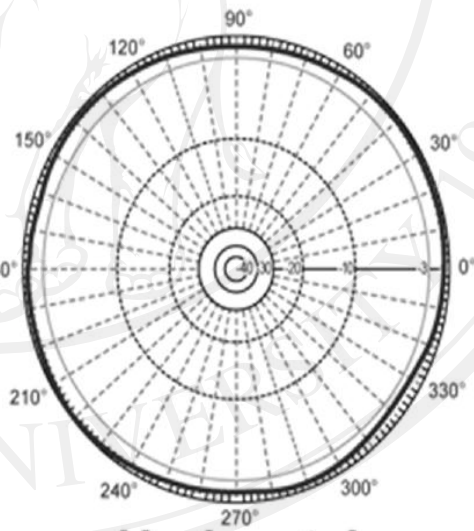
Dimensions	7.32" x 1.89" x 7.87" (186 x 48 x 200 mm)
Weight	17.0 oz (482 g)
Power	12VDC, 1A
Certification	FCC, ICES-003, CE, Wi-Fi (802.11b, 802.11g), WPA2, WMM
Operating Temp.	32 to 104°F (0 to 40°C)
Storage Temp.	-4 to 158°F (-20 to 70°C)
Operating Humidity	10 to 85% Noncondensing
Storage Humidity	5 to 90% Noncondensing



- Used in most access point
- Omni directional
 - “doughnut” pattern
- Gain : 2 dBi



Vertical



Horizontal



www.rovingnetworks.com

RN-131G

rn-131-ds v2.3 5/28/2009

"WiFly GSX" 802.11G Module

Features

- Qualified 2.4GHz IEEE 802.11b/g transceiver
- High throughput, 1Mbps sustained data rate with TCP/IP and WPA2
- Ultra-low power - 4uA sleep, 40mA Rx, 210mA Tx (max)
- Small, compact surface mount module
- On board ceramic chip antenna and U.FL connector for external antenna
- 8 Mbit flash memory and 128 KB RAM
- UART hardware interface
- 10 general purpose digital I/O
- 8 analog sensor interfaces
- Real-time clock for wakeup and time stamping
- Accepts 3.3V regulated or 2-3V battery
- Supports Adhoc connections
- On board ECOS -OS, TCP/IP stacks
- Wi-Fi Alliance certified for WPA2-PSK
- FCC / CE / ICS certified and RoHS compliant.

Applications

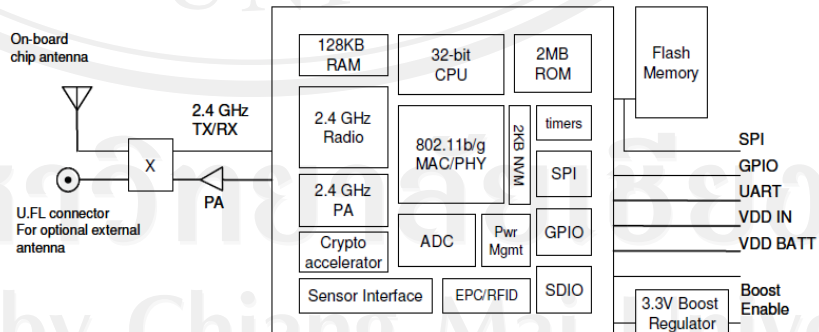
- Wireless audio
- Remote equipment monitoring
- Telemetry
- Security
- Industrial sensors and controls
- Home Automation
- Medical devices



Description

The WiFly GSX module is a stand alone, embedded wireless 802.11 networking module. Because of its small form factor and extremely low power consumption, the RN-131G is perfect for mobile wireless applications such as asset monitoring, GPS tracking and battery sensors. The WiFly GSX module incorporates a 2.4GHz radio, processor, TCP/IP stack, real-time clock, crypto accelerator, power management and analog sensor interfaces. This complete solution is preloaded with software to simplify integration and minimizes development of your application. In the simplest configuration the hardware only requires four connections (PWR, TX, RX, GND) to create a wireless data connection. Additionally, the sensor interface provides temperature, audio, motion, acceleration and other analog data without requiring additional hardware. The WiFly GSX module is programmed and controlled with a simple ASCII command language. Once the WiFly GSX is setup it can scan to find an access point, associate, authenticate and connect over any Wifi network.

Block Diagram





RN-131G

www.rovingnetworks.com

rn-131-ds v2.3 5/28/2009

Overview

- Host Data Rate up to 1 Mbps for UART
- Intelligent, built-in power management with programmable wakeup
- Can be powered from regulated 3.3-3.7V source or 2.0-3.0V batteries
- Real time clock for time stamping, auto-sleep and auto-wakeup
- Configuration over UART using simple ASCII commands
- Web Server or Telnet configuration over WiFi
- Over the air firmware upgrade (FTP)
- Memory 128 KB RAM, 2MB ROM, 2 KB battery-backed memory, 8 Mbit Flash.
- Secure WiFi authentication WEP-128, WPA-PSK (TKIP), WPA2-PSK, EAP-TLS for WPA1 & WPA2 Enterprise
- Built in networking applications DHCP, UDP, DNS, ARP, ICMP
- 802.11 power save and roaming functions

Environmental Conditions

Parameter	Value
Temperature Range (Operating)	-40 °C ~ 85 °C
Temperature Range (Storage)	-40 °C ~ 85 °C
Relative Humidity (Operating)	≤90%
Relative Humidity (Storage)	≤90%

Electrical Characteristics

Supply Voltage	Min	Typ.	Max.	Unit
Supply Voltage VDD	3.0	3.3	3.7	VDC
Supply Voltage (VBATT option)	2.0	3.0	3.3	VDC
Power consumption				
Sleep		4		uA
Standby (doze)	-	15	-	mA
Connected (idle, RX)		40		mA
Connected (TX)		140	212	mA

Radio Characteristics

Parameter	Specifications
Frequency	2402 ~ 2480MHz
Modulation	DSSS(CCK-11, CCK-5.5, DQPSK-2, DBPSK-1)
Channel intervals	5MHz
Channels	1 - 14
Transmission rate (over the air)	1 – 11Mbps for 802.11b / 6 – 54Mbps for 802.11g
Receive sensitivity	-85dBm typ.
Output level (Class1)	+18dBm
Maximum RF input to U.FL connector	10 dBm

ประวัติผู้เขียน

ชื่อ-สกุล

นายสุนิท อ้อพรมมา

วัน เดือน ปี เกิด

23 กุมภาพันธ์ 2526

ประวัติการศึกษา

สำเร็จการศึกษามัธยมศึกษาตอนปลาย

โรงเรียนมัธยมสมบูรณ์พันซำ (สปป.ลาว) ปีการศึกษา 2545

สำเร็จการศึกษาระดับปริญญาวิทยาศาสตรบัณฑิต

สาขาวิชาวิศวกรรมอิเล็กทรอนิกส์

มหาวิทยาลัยแห่งชาติลาว ปีการศึกษา 2550

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่

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