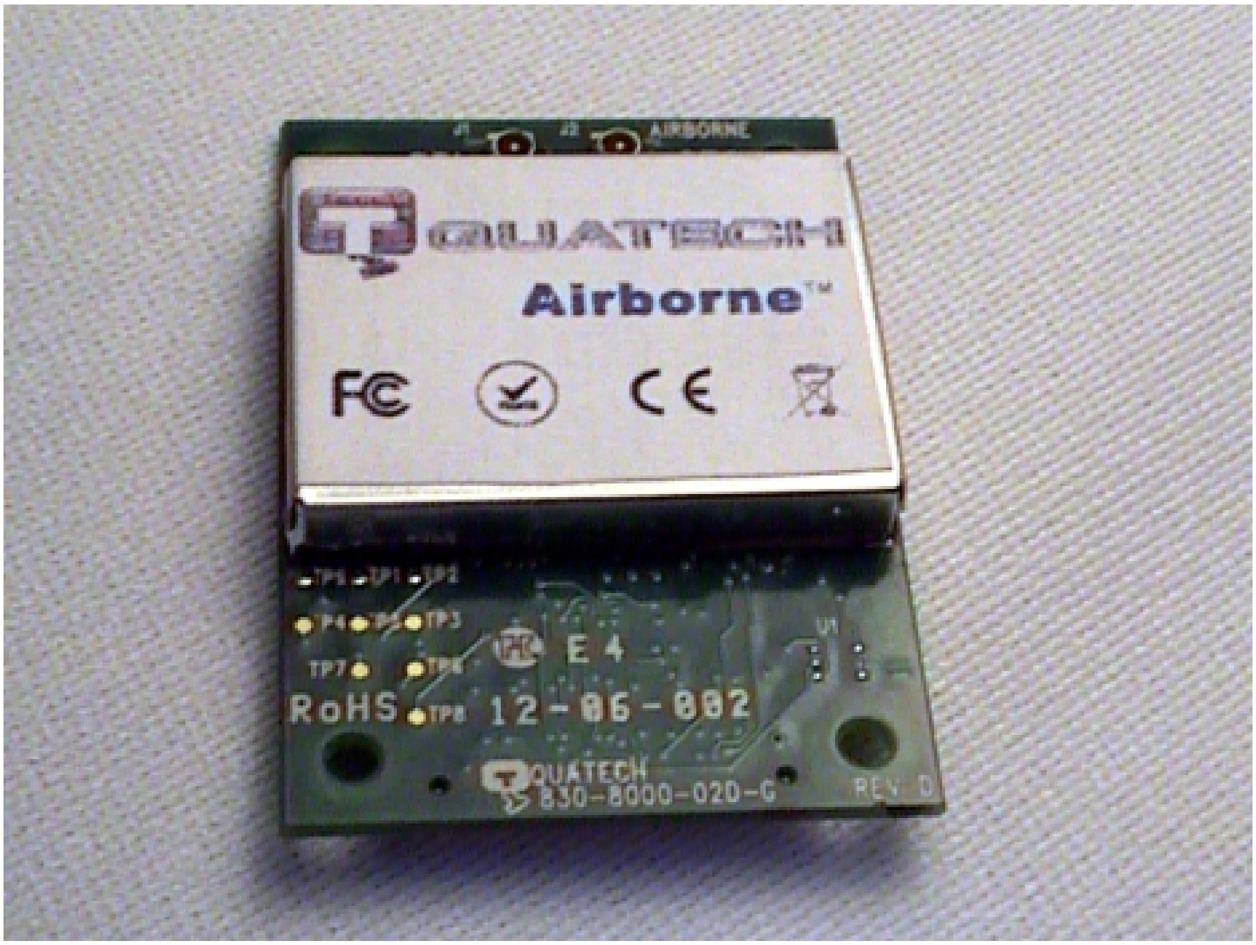

Airborne™ 802.11b/g Radio Module Data Book

Quatech, Inc. Confidential

Disclaimer

The information in the document is believed to be correct at the time of print. The reader remains responsible for the system design and for ensuring that the overall system satisfies its design objectives taking due account of the information presented herein, the specifications of other associated equipment, and the test environment.

QUATECH ® Inc. has made commercially reasonable efforts to ensure that the information contained in this document is accurate and reliable. However, the information is subject to change without notice. No responsibility is assumed by QUATECH for the use of the information, nor for infringements of patents or other rights of third parties. This document is the property of QUATECH ® Inc.. and does not imply license under patents, copyrights, or trade secrets.

Quatech, Inc. Headquarters

QUATECH ® Inc..
5675 Hudson Industrial Parkway
Hudson, OH 44236
USA

Telephone: 330-655-9000
Toll Free: 800-553-1170
Fax: 330-655-9010
Technical Support: 714-899-7543 / wirelesssupport@Dpactech.com

Web Site: www.quatech.com

CONTENTS

LIST OF FIGURES

LIST OF TABLES

This page intentionally left blank

CHAPTER 1
INTRODUCTION

1.1 OVERVIEW

Airborne™ is a line of highly integrated 802.11b/g modules. The Airborne™ Radio Module delivers a highly integrated solution for consumer and industrial wireless applications using the industry-standard IEEE 802.11b/g platform. It delivers both a cost and space efficient solution using a small profile design and direct down SMT high density header (Zero-IF) connection to the system board.

The two-chip design significantly reduces product cost and form factor. It is a complete high-speed wireless solution that uses the latest 802.11b/g chipset from Marvell which is backward compatible with the 802.11b DSSS standard and adds the new 802.11g OFDM (orthogonal Frequency Division Multiplexing) standard support. This chip set includes integrated antenna connectors that provide a direct connection from the radio to the antenna. This bypasses the system board, which simplifies the integrator's board design. The radio is a true upgrade option because no soldered connections are required. It can be upgraded in the field or added to a managed product configuration.

1.2 CONFIGURATIONS

The Airborne™ Radio Module consists of an 802.11b/g radio transceiver and Media Access Controller (MAC) with a Compact Flash (CF) interface.

Table 1. Airborne™ Radio Module Configuration

Configuration	Description	QUATECH Part Number
Airborne™ Radio Module	Supports 802.11b/g radio transceiver and MAC with CF (Compact Flash) Card interface.	WLRG-RA-DP101

1.3 FEATURES

1.3.1 General Features

- Highly integrated IEEE 802.11b/g wireless module with radio and baseband processor
- IEEE 802.11b/g support up to 54Mbps OFDM(G-Mode) as well as up to 11Mbps DSSS (B-Mode) legacy rates
- Seamless roaming within the IEEE 802.11b/g WLAN infrastructure

- IEEE 802.11b/g-compatible, allowing interoperation among vendors who also adhere to the IEEE 802.11 specification
- Auto fallback: 11 Mbps, 5.5 Mbps, 2 Mbps, and 1 Mbps data rates for 802.11b mode and 54Mbps, 48Mbps, 36Mbps, 24Mbps, 18Mbps, 12Mbps, 9Mbps, and 6Mbps
- 64-bit or 128-bit WEP encryption, set by ASCII and Hexadecimal modes
- Small size: 38 x 27 x 4.2 mm
- Supports site survey functions
- Power Saving Mode to prolong battery life
- Complies with Wi-Fi standards

1.3.2 Radio Features

- IEEE 802.11b/g 54 Mbps/2.4 GHz optimized for consumer and industrial applications
- Marvell chipset designed for increased battery life
- Performance optimized for web pads, mobile MP3, and other Internet appliances
- Wi-Fi Protected Access™ support
- On-chip A/D and D/A converters for I/Q data, AGC, and adaptive power control
- Designed to meet FCC Part 15 regulatory requirements for operation in 2.4GHz ISM band
- Support for 802.11b mode 11, 5.5, 2 and 1 Megabit Per Second (Mbps) Data Rates as well as 802.11g mode 54Mbps, 48Mbps, 36Mbps, 24Mbps, 18Mbps, 12Mbps, 9Mbps, and 6Mbps Data Rates
- Supports the IEEE 802.11b Direct Sequence Specification as well as 802.11g OFDM Specification
- Supports Dual Diversity Antennas
- Intelligent Power Control, Including Low Power Standby Mode

1.3.3 Medium Access Controller and Baseband Processor Features

- Enhanced performance WEP engine
- Debug mode supports tracing execution from on-chip memory
- Complete DSSS baseband processor for B-Mode and OFDM baseband processor for G-Mode
- Processing gain is FCC compliant (B-Mode)
- Programmable data rate is 1, 2, 5.5, and 11Mbps for B-Mode and 54Mbps, 48Mbps, 36Mbps, 24Mbps, 18Mbps, 12Mbps, 9Mbps, and 6Mbps for G-Mode
- Modulation methods: DBPSK, DQPSK, and CCK for B-Mode and BPSK, QPSK, 16-QAM, and 64-QAM for G-Mode

- Supports half duplex operation
- Supports short preamble (B-Mode) and antenna diversity (Rx only)

1.4 MODULE BLOCK DIAGRAM

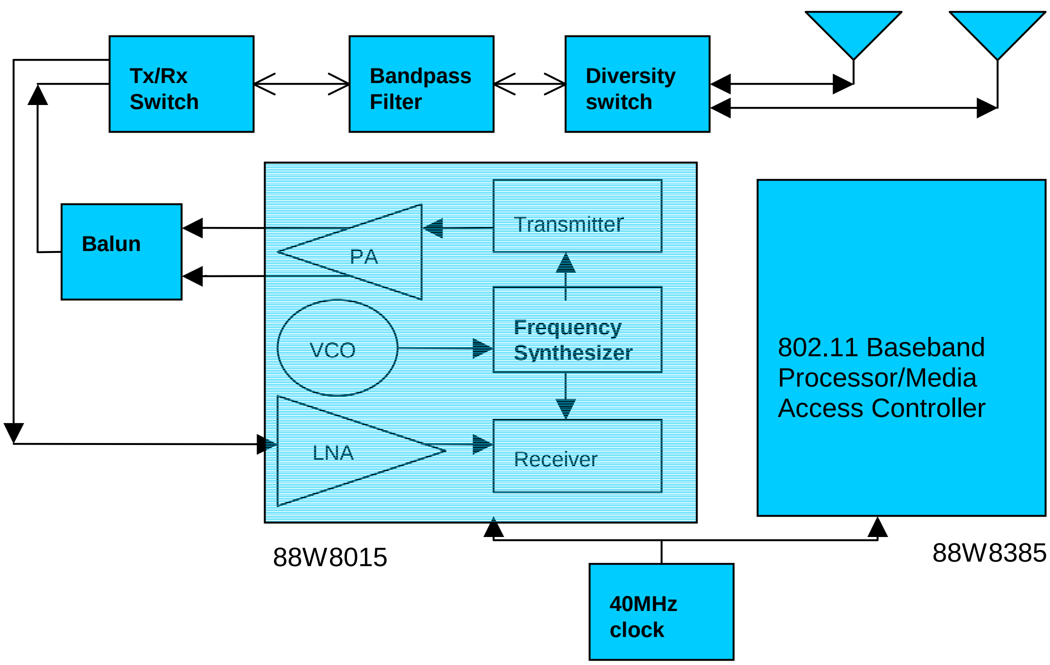

Figure 1. Airborne™ Radio Module Block Diagram

1.5 USING THIS DOCUMENT

In addition to this chapter, this guide contains the following chapters and appendixes:

- *Chapter 2, Specifications*
- *Chapter 3, Application*
- *Appendix A, Radio Frequency Channels*
- *Appendix B, Glossary*

1.6 CONVENTIONS

1.6.1 Terminology

"Airborne(TM) Radio Module" identifies this Module the first time in a chapter. Thereafter, the term "Module" is used.

1.6.2 Notes

A note is information that requires special attention. The following convention is used for notes.

Note	A note contains information that deserves special attention.

1.6.3 Cautions

A caution contains information that, if not followed, can cause damage to the product or injury to the user. The following convention is used for cautions.

Caution!	A caution contains information that, if not followed, can cause damage to the product or injury to the user.

1.7 RELATED DOCUMENTATION

The following related documentation is available on the Airborne™ Radio Evaluation Kit CD:

- Airborne™ Radio Data Book TBD.
- Airborne™ PCMCIA Adapter Reference Manual 39L3715-01
- QUATECH Airborne Product briefs

The following related documentation is available from Marvell:

These documents are provided as Portable Document Format (PDF) files. To read them, you need Adobe Acrobat Reader 4.0.5 or higher. For your convenience, Adobe Reader is provided on the Evaluation Kit CD. For the latest version of Adobe Acrobat Reader, go to the Adobe Web site (www.adobe.com).

Please contact your local Marvell Sales Representative to locate referenced Marvell drawings and documents or visit the Marvell website at *www.marvell.com*. Some of the referenced documents require

Non-Disclosure Agreements and Developer Status with Marvell. QUATECH will not provide support for any of the Marvell Reference documentation.

1.8 FCC STATEMENT

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for assistance.

Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device

1.9 FCC RF EXPOSURE STATEMENT

To satisfy RF exposure requirements, this device and its antenna must operate with a separation distance of a least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

1.10 INFORMATION FOR CANADIAN USERS (IC NOTICE)

This device has been designed to operate with an antenna having a maximum gain of 5dBi. An antenna having a higher gain is strictly prohibited per regulations of Industry Canada. The required antenna impedance is 50 ohms.

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than required for successful communication.

Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device

2.1 ELECTRICAL SPECIFICATIONS

Table 2. Electrical Supply Specifications for Airborne™ Radio Module

Specification		Description
Supply		3.3 VDC
Power Up Inrush Current		3000 mA (max)
Clock Frequencies	802.11CPU reference clock	40 MHz

Table 3. Electrical Specifications for Airborne™ Radio Module

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Current Consumption						
Initialization Current	I_{CC}			XX		mA
Quiescent Current	I_{CC}			XX		mA
Continuous Transmit Mode	I_{CC}			XX		mA
Continuous Receive Mode	I_{CC}	Receiving Valid Packets		XX		mA
IEEE 802.11 Power Save Mode	I_{CC}	RX On, 100 msec Beacon Intervals		XX		mA
PCMCIA Logic Levels						
Input HIGH Voltage	V_{IH}	V_{CC}=Max, Min	0.7V_{CC}			V
Input LOW Voltage	V_{IL}	V_{CC}=Min, Max			0.3V_{CC}	V
Output HIGH Voltage	V_{OH}	I_{OL} = 2mA, VCC=Min		2.6		V
Output LOW Voltage	V_{OL}	I_{OL} = 2mA, VCC=Min		0.05		V
Input Leakage Current	I_I	V_{CC}=Max, Input=0V or V_{CC}		0.1	1.0	µA
PCMCIA Loading Capacitance						
Input Capacitance	C_{IN}			5	10	pF

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Output Capacitance	C_{OUT}			5	10	pF
RF System Specifications						
B-Mode Transmitter Power Output	P_{out}			15		dBm
G-Mode Transmitter Power Output				12		
Receive Sensitivity	R_{X_S}	1 Mbps, 8% PER		-87		dBm
		2 Mbps, 8% PER		-87		dBm
		5.5 Mbps, 8% PER		-86		dBm
		11 Mbps, 8% PER		-85		dBm
		54Mbps, 10% PER		XX		
		36Mbps, 10% PER		XX		
		18Mbps, 10% Per		XX		
		6Mbps, 10% PER		XX		
Multipath Delay Spread Using IEEE 802.11 Naftali Model	T_{DELAY}	1 Mbps, 8% PER		>290		ns
		2 Mbps, 8% PER		>290		ns
		5.5 Mbps, 8% PER		166		ns
		11 Mbps, 8% PER		90		ns
		54Mbps, 10% PER		XX		
		36Mbps, 10% PER		XX		
		18Mbps, 10% Per		XX		
		6Mbps, 10% PER		XX		
Multipath Receive Sensitivity Using JTC Models	R_{X_SJTC}	1 Mbps, 8% PER, JTC Commercial B (150 nsec)		-82		dBm
		2 Mbps, 8% PER, JTC Commercial B (150 nsec)		-80		dBm
		5.5 Mbps, 8% PER, JTC Commercial B (150 nsec)		-76		dBm

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
		11 Mbps, 8% PER, JTC Office B (100 nsec) 54Mbps, 10% PER 36Mbps, 10% PER 18Mbps, 10% Per 6Mbps, 10% PER		-67 XX XX XX XX		dBm
Maximum Receive Level	R_{X_MAX}	PER <8% (B-Mode) PER <10% (G-Mode)		+3 -10		dBm
Third Order Intercept Point (Input)	IIP3_90	-90 dBm input		-3		dBm
	IIP3_25	-25 dBm input		20		dBm
Carrier Suppression	T_{X_sup}	Test Mode		42.5		dB
Image Rejection	I_R	PER <8%		60		dB
Adjacent Channel Rejection	ACR	PER <8% B-Mode(Note 2) PER<10% G-Mode		46 XX		dB
Data Rate (Physical Layer) B-Mode and G-Mode	Rate			1, 2, 5.5, 11, 6, 9, 12, 18, 24, 36, 48, 54		Mbps

Note

1. Test Conditions: Supply Voltage (V_{CC}) = 3.3V, Ambient Temperature (T_A) = 25^{o}C, unless otherwise specified.
2. The adjacent channel measurement is carried out on two channels separated by 25MHz (5 channels).

2.1.1 Absolute Maximum Ratings

Table 4. Absolute Maximum Ratings and Operating Environment

Specification	Description
Supply Voltage Range	3.0V to 3.6V
Supply Voltage	-0.3V to 4.0V (Max)
Temperature Range	-40°C ~ T_A ~ 85°C
Storage Temperature	-55°C to 125°C

Note

All temperature references refer to ambient conditions.

Caution!

These are the absolute maximum ratings for the Airborne™ Radio Module. Exceeding these limits could cause permanent damage to the card.

2.1.2 *Electrical Characteristics*

Table 5. Electrical Characteristics

Symbol	Parameter	Min	Typ	Max	Unit
V_{DD}	Supply Voltage (3.3V ±5%)	3.135	3.3	3.465	V
I_{DDTX}	Transmit Mode Current (B-Mode) G-Mode		450 475	500 525	mA
I_{DDRX}	Receive Mode Current		275	325	mA
$I_{DDSLEEP}$	Sleep Mode Current		100	200	mA
V_{IHGP}	GPIO Input High voltage	1.8		5.5	V
V_{ILGP}	GPIO Input Low voltage			1.0	V
V_{OHGP}	GPIO Output High voltage	2.4		V_{DD}	V
V_{OLGP}	GPIO Output Low voltage			0.4	V
I_{OHGP}	GPIO Output High Current Port E5 and Port E6 only			24 60	mA
I_{OLGP}	GPIO Output Low Current Port E5 and Port E6 only			16 40	mA
V_{IHAn}	Analog Input High voltage	1.8		2.5	V
V_{ILAN}	Analog Input Low voltage			1.0	V
V_{OHAn}	Analog Output High voltage	2.4		2.5	V
V_{OLAn}	Analog Output Low voltage			0.4	V
I_{OHAn}	Analog Output High Current			6	mA
I_{OLAn}	Analog Output Low Current			6	mA
S_{VDD}	D_{VDD} slew rate to ensure Power-On reset	0.05			V/ms

2.2 RADIO FREQUENCY SPECIFICATIONS

Table 6. Radio Frequency Specifications

Specification	Description
RF Power	+15 dBm (typical) Approx.32 mW for B-Mode and +12dBm (typical) Approx 16mW for G-Mode
Sensitivity	-82 dBm for 11 Mbps -86 dBm for 5.5 Mbps -88 dBm for 2 Mbps -90 dBm for 1 Mbps -71 dBm for 54Mbps -77 dBm for 36Mbps -83 dBm for 18Mbps -xx dBm for 6Mbps
Frequency	2.4 – 2.4835 GHz (US/Canada/Japan/Europe) 2.471 – 2.497 GHz (Japan)
Modulation	DQPSK, DBPSK, and CCK for B-Mode BPSK, QPSK, 16-QAM, and 64-QAM for G-Mode
Channels	USA/Canada: 11 channels (1 –11) Europe: 13 channels (1 –13) Japan: 14 channels (1 –14) for B-Mode and channels 1-13 for G-Mode France: 4 channels (10 –13)

2.2.1 AC Electrical Characteristics – Transmitter

Transmit power is automatically managed by the device for minimum power consumption. The transmit power is typically +15 ± 2 dB for B-Mode and +12+/-2dB for G-Mode

2.2.2 Performance/Range

The following table illustrates the typical data rates, performance and range the device is capable of providing using an omni directional antenna.

Table 7. Performance/Range*

Data Rate	Indoor Distance	Outdoor Distance (Max)
11.0 Mb/s	30 – 100 m	300 m
5.5 Mb/s	32 – 107 m	330 m
2.0 Mb/s	35 – 115 m	375 m
1.0 Mb/s	40 – 130 m	400 m

* Ranges are based on signal-to-noise ratio and performance estimates. Actual maximum throughput will depend upon host performance.

Note

- Data Rate is the raw data rate provided over the wireless link.
- Throughput is the data rate provided through the TCP/IP Stack.
- Indoor Distance is “Office Environment”.
- Outdoor Distance is “Open Field”.

2.3 INTERFACE SPECIFICATIONS

2.3.1 Interface Specifications

50 pin connector (PN: HRS DF12-50DS-0.5V)

2.3.2 Pin Assignments

Table 8. Pin Assignments

Pin	Signal	Pin I/O Type	Description
1	RF_VCC	Power, 0.35A	DC Power Supply 3.3V ±5%
2	RF_VCC	Power, 0.35A	DC Power Supply 3.3V ±5%
3	RF_VCC	Power, 0.35A	DC Power Supply 3.3V ±5%
4	RF_VCC	Power, 0.35A	DC Power Supply 3.3V ±5%
5	A00	5V tol, BiDir, 2mA, 50K Pull Down	Host Address Input, Bits 0
6	D00	5V tol, BiDir, 2mA, 50K Pull Down	Host Data Bus, Bits 0
7	A01	5V tol, BiDir, 2mA, 50K Pull Down	Host Address Input, Bits 1

Pin	Signal	Pin I/O Type	Description
8	D01	5V tol, BiDir, 2mA, 50K Pull Down	Host Data Bus, Bits 1
9	A02	5V tol, BiDir, 2mA, 50K Pull Down	Host Address Input, Bits 2
10	D02	5V tol, BiDir, 2mA, 50K Pull Down	Host Data Bus, Bits 2
11	A03	5V tol, BiDir, 2mA, 50K Pull Down	Host Address Input, Bits 3
12	D03	5V tol, BiDir, 2mA, 50K Pull Down	Host Data Bus, Bits 3
13	A04	5V tol, BiDir, 2mA, 50K Pull Down	Host Address Input, Bits 4
14	D04	5V tol, BiDir, 2mA, 50K Pull Down	Host Data Bus, Bits 4
15	A05	5V tol, BiDir, 2mA, 50K Pull Down	Host Address Input, Bits 5
16	D05	5V tol, BiDir, 2mA, 50K Pull Down	Host Data Bus, Bits 5
17	A06	5V tol, BiDir, 2mA, 50K Pull Down	Host Address Input, Bits 6
18	D06	5V tol, BiDir, 2mA, 50K Pull Down	Host Data Bus, Bits 6
19	A07	5V tol, BiDir, 2mA, 50K Pull Down	Host Address Input, Bits 7
20	D07	5V tol, BiDir, 2mA, 50K Pull Down	Host Data Bus, Bits 7
21	A08	5V tol, BiDir, 2mA, 50K Pull Down	Host Address Input, Bits 8
22	GND	Ground	Digital Ground
23	A09	5V tol, BiDir, 2mA, 50K Pull Down	Host Address Input, Bits 9
24	D08	5V tol, BiDir, 2mA, 50K Pull Down	Host Data Bus, Bits 8
25	GND	Ground	Digital Ground
26	D09	5V tol, BiDir, 2mA, 50K Pull Down	Host Data Bus, Bits 9
27	OE#	5V tol, BiDir, 2mA, 50K Pull Up	Host Memory Attribute Space Output Enable
28	D10	5V tol, BiDir, 2mA, 50K Pull Down	Host Data Bus, Bits 10
29	WE#	5V tol, CMOS, Input, 50K Pull Up	Host Memory Attribute Space Write Enable
30	D11	5V tol, BiDir, 2mA, 50K Pull Down	Host Data Bus, Bits 11
31	IORD#	5V tol, BiDir, 2mA, 50K Pull Up	Host I/O Space Read Strobe
32	D12	5V tol, BiDir, 2mA, 50K Pull Down	Host Data Bus, Bits 12
33	IOWR#	5V tol, BiDir, 2mA, 50K Pull Up Host	Space I/O Write Strobe
34	D13	5V tol, BiDir, 2mA, 50K Pull Down	Host Data Bus, Bits 13
35	CE1#	5V tol, BiDir, 2mA, 50K Pull Up Host	Select, Low Byte
36	D14	5V tol, BiDir, 2mA, 50K Pull Down	Host Data Bus, Bits 14

Pin	Signal	Pin I/O Type	Description
37	CE2#	5V tol, BiDir, 2mA, 50K Pull Up Host	Select, High Byte
38	D15	5V tol, BiDir, 2mA, 50K Pull Down	Host Data Bus, Bits 15
39	GND	Ground	Digital Ground
40	GND	Ground	Digital Ground
41	RESET	5V tol, CMOS, ST (Schmitt Trigger) Input, 50K Pull Up	Hardware Reset
42	IREQ#	5V tol, BiDir, 2mA, 50K Pull Up	Host interrupt Request (I/O Mode), also used as the Module's Ready (Memory Mode) output which is asserted to indicate Module initialization is complete
43	REG#	5V tol, BiDir, 2mA, 50K Pull Up	Host Attribute Space Select Memory mode: H for common memory, L for attribute memory. The signal must be low during I/O cycles when the I/O address is on the bus.
44	WAIT#	CMOS Output, 4mA, 10K Pull Up	Host device must provide a 10K Pull Up
45	RF_LED#	Input, 9mA	LED cathode
46	IOIS16#	Pull Low, Output	8 Bits or 16 Bits I/O Card selected L: 16 bit or odd byte only operation
47	STSCHG#	CMOS Output, 4mA 50K Pull Up	Host Status Change Shows the BVD1 (Battery Voltage Detect), BVD2, WP (Write Protect), or Ready status changed.
48	CD1#	Pull Low, Output	Card Detect
49	GND	Ground	Digital Ground
50	INPACK#	CMOS BiDir, 2mA, 50K Pull Up	Host I/O Decode Confirmation. Asserted by the Module when selected and responding to an I/O read cycle. Used to control the HBA (Host Bus Adaptor) tri-state buffer on/off).

Note

The interface is a subset of a PC Card interface.

*2.3.3 Pin Features**

The following describes specific features of various pins:

Table 9 - Pin Definition and Descriptions

Pin feature	Description
A[9:0]	Decoding of the system address space is performed by the CEx-. During I/O accesses A[5:0] decode the register. A[9:6] are ignored when the internal HAMASK register is set to the defaults used by the standard firmware. During attribute memory accesses A[9:1] are used.
D[15:0]	The host interface is primarily designed for word accesses, although all byte access modes are fully supported. See CE1-, CE2- for a further description. Note that attribute memory is specified for and operates with even bytes accesses only.
CE1-, CE2-	The PC Card cycle type and width are controlled with the CE signals. Word and Byte wide accesses are supported, using the combinations of HCE1-, HCE2-, and HA0 as specified in the PC Card standard.
WE-, OE	HOE and HWE- are only used to access attribute memory. Common Memory, as specified in the PC Card standard, is not used in the MODULE. HOE- is the strobe that enables an attribute memory read cycle. HWE- is the corresponding strobe for the attribute memory write cycle. The attribute space contains the Card Information Structure (CIS) as well as the Function Configuration Registers (FCR).
IORD-, IOWR	IORD-and HIOWR- are the enabling strobes for register access cycles to the MODULE. These cycles can only be performed once the initialization procedure is complete and the MODULE has been put into IO mode.
REG	This signal must be asserted for I/O or attribute cycles. A cycle where HREG- is not asserted will be ignored as the MODULE does not support common memory.
INPACK	This signal is asserted by the MODULE whenever a valid I/O read cycle takes place. A valid cycle is when HCE1-, HCE2-,- HREG-, and HIORD- are asserted, once the initialization procedure is complete.

Pin feature	Description
WAIT	Wait states are inserted in accesses using HWAIT-. The host interface synchronizes all PC Card cycles to the internal MODULE clock. The following wait states should be expected: **Direct Read or Write to Hardware Register** • 1/2 to 1 MCLK assertion of HWAIT- for internal synchronization. Write to Memory Mapped Register, Buffer Access Path, or Attribute Space (Post-Write) • The data required for the write cycle will be latched and therefore only the synchronizing wait state will occur. • Until the queued cycle has actually written to the memory, any subsequent access by the Host will result in a WAIT. **Read to Attribute Space and Memory Mapped Registers** • WAIT will assert until the memory arbitration and access have completed. **Buffer Access Paths, BAP0 and BAP1** • An internal Pre-Read cycle to memory is initiated by a host Buffer Read cycle, after the internal address pointer has auto-incremented. If the next host cycle is a read to the same buffer, the data will be available without a memory arbitration delay. • A single register holds the pre-read data. Thus, any read access to any other memory-mapped register (or the other buffer access path) would result in the pre-read data becoming invalidated. • If another read cycle has invalidated the pre-read, then a memory arbitration delay will occur on the next buffer access path read cycle.
IREQ	Immediately after reset, the HIREQ- signal serves as the RDY/BSY (per the PC Card standard). Once the MODULE firmware initialization procedure is complete, HIREQ- is configured to operate as the interrupt to the PC Card socket controller. Both Level Mode and Pulse Mode interrupts are supported. By default, Level mode interrupts are used, so the interrupt source must be specifically acknowledged or disabled before the interrupt will be removed.
Register Interface	The logical view of the MODULE from the host is a block of 32-word wide registers. These appear in IO space starting at the base address determined by the socket controller.
Hardware Registers (HW)	• 1 to 1 correspondence between addresses and registers. • No memory arbitration delay, data transfer directly to/from registers. • AUX base and offset are write-only, to set up access through AUX data port. Note: All register cycles, including hardware registers, incur a short wait state on the PC Card bus to insure the host cycle is synchronized with the MODULE's internal MCLK.

2.3.4 *Antenna Pin Assignments and Descriptions*

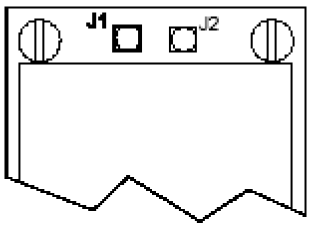

Figure 2. Antenna Connectors

Table 10. Airborne™ Radio Module Antenna Pin Assignments

Assignment	Description
J1 (left connector)	Antenna 1
J2 (right connector)	Antenna 2

2.4 MECHANICAL SPECIFICATIONS

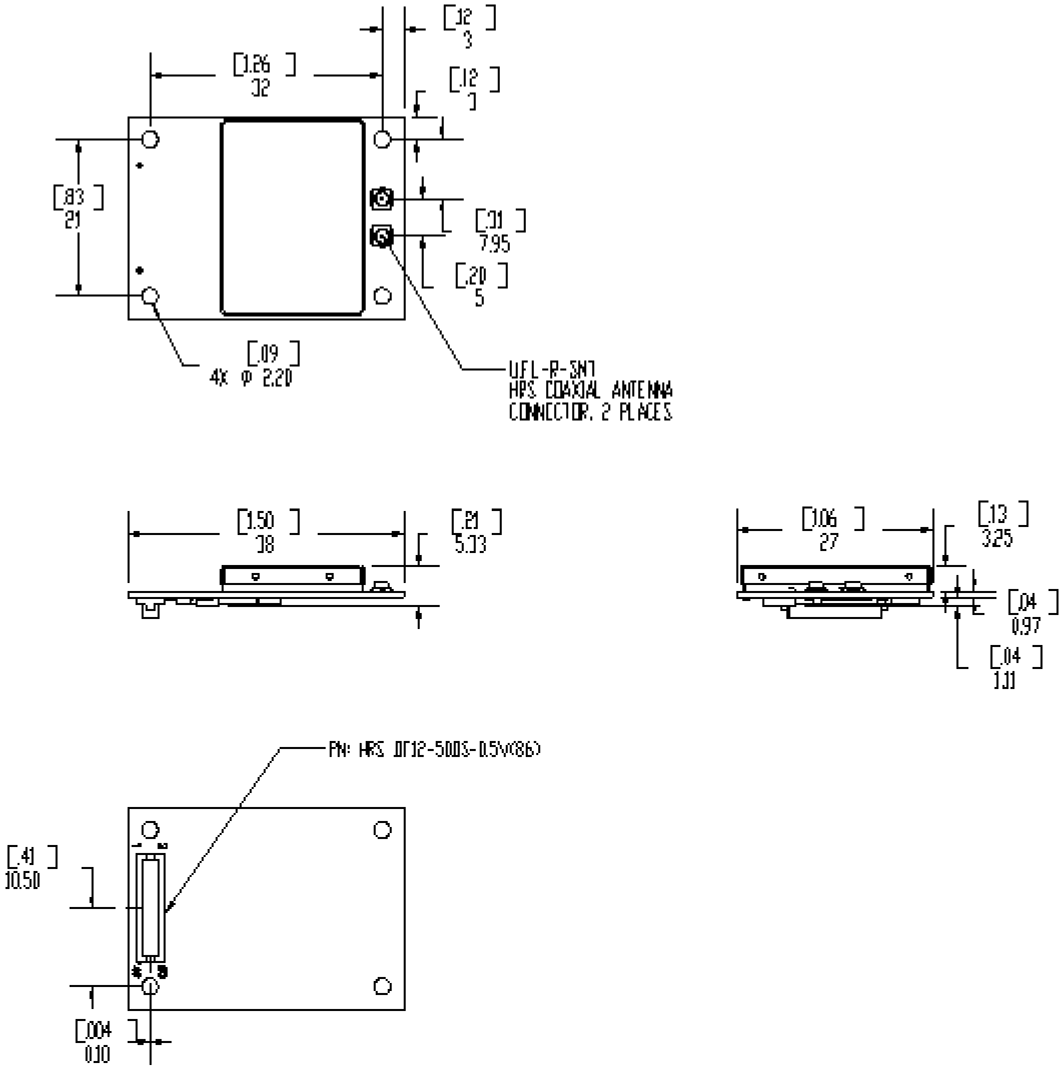

Figure 3. Mechanical Dimensions

CHAPTER 3
APPLICATION

3.1 DESIGN GUIDELINES

The Module can be implemented into various solutions. Any design must meet the following guidelines:

- Provide 3.3 V to all V_{dd} power pins.
- Provide ground connections to all V_{ss} pins.
- Provide a connection to a suitable antenna.

Caution!

> The 3.3 V power supply should be a low-noise design, with less than 150 mV ripple at the maximum average transmit current. The power supply should also be designed to provide sufficient power to handle the Module's power-up inrush current.

3.2 EMI/RFI GUIDELINES

To minimize electromagnetic interference (EMI) and radio frequency interference (RFI), pay strict attention to power and signal routing near the Module. As much as possible, the keep-clear area below the Module should be a solid copper ground plane. It is anticipated that the Module will be mounted on a board with a committed ground plane. Ensure the inter-connect has a designed impedance of 50-75 Ohms.

To keep signal impedance as low as possible, connect the ground plane to internal ground planes by several vias. Ground signals to the Module connector should connect directly to the ground plane below the Module. Individual ground connections to the Module should have a solid ground connection, preferably directly to the ground plane on the same surface side where the Module resides. Do not connect ground pins directly to an inside layer ground plane using vias.

Keep interconnects from the Module connector as short as possible on the mounting layer. All inboard signals–including pin numbers–must immediately transition to a different routing layer using a via as close to the connector as possible. Outboard signals (odd pin numbers) should also be kept to a minimum length.

3.3 CIRCUIT BOARD LAYOUT PRACTICES

When considering capacitance, calculations must consider all device loads and capacitances due to printed circuit board traces. Capacitance due to the traces depend on a number of factors, including the trace width, dielectric material from which the circuit board is made, and proximity to ground and power planes.

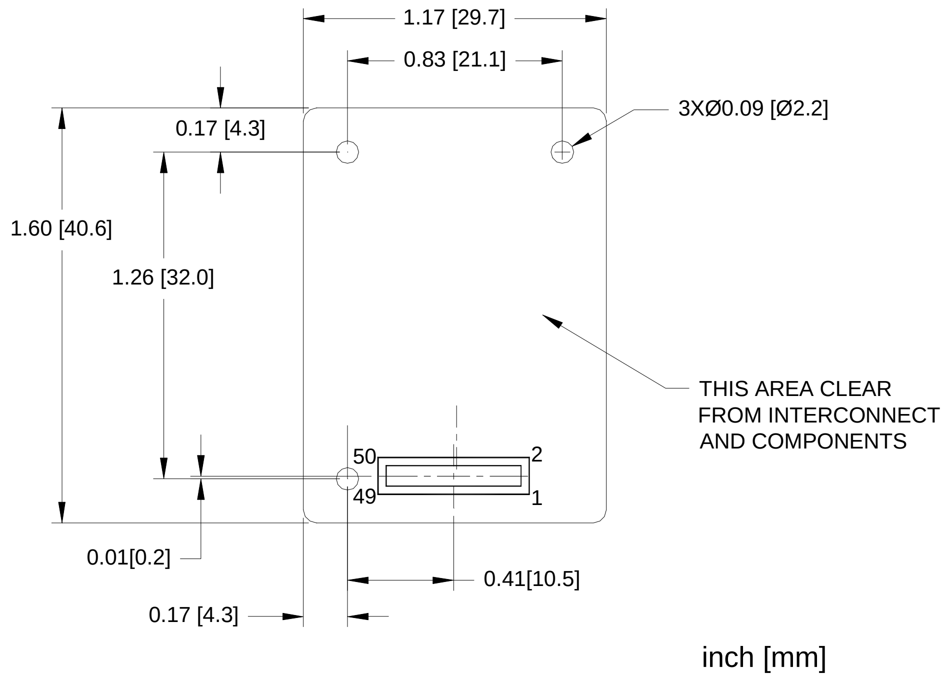

Figure 4. Guidelines for Mounting the Radio Module

3.4 MOUNTING GUIDELINES

Special care must be observed when placing the Module. In particular:

- The antenna must not be mounted beneath any other printed circuit boards, components, or metallic housing.
- The proximity of the antenna to large metallic objects can affect the range and performance of the Module.
- Packaging and enclosure designers must carefully review the placement of the Module in the enclosure to minimize interference or blocking sources.

For mechanical clearance, performance, and emissions reasons, there should be no components placed on the main printed circuit board facing the Module. This region should be clear of components.

Note

Suggested mounting: Use three non conductive spacers with the following dimensions:

O/D Diameter 0.187 x I/D Diameter 0.096 x Length 0.156

APPENDIX A: RADIO FREQUENCY CHANNELS

A.1. USING RADIO FREQUENCIES

IEEE 802.11 devices such as the Airborne™ Radio Module use radio-frequency signals in the Industrial, Scientific, and Medical (ISM) band between 2.4 GHz and 2.5 GHz to communicate with each other.

Due to spread spectrum effect of the signals, a radio sending signals on a particular channel uses the frequency spectrum 12.5 MHz above and below the center channel frequency. As a result, two separate WLANs in the same general vicinity that use neighboring channels (channel 1 and channel 2, for instance) can interfere with each other. Applying two channels that allow the maximum channel separation decreases the amount of channel cross-talk and provides performance gains over networks with minimal channel separation.

The preferred channel separation between the channels in neighboring wireless networks is 25 MHz (5 channels). Neighboring channels are 5 MHz apart. To minimize adjacent channel interference, you can apply a maximum of three different channels within your WLAN. There are 11 usable wireless channels in the United States. It is recommended that you start using channel 1 and grow to use channel 6, and 11 when necessary, as these three channels do not overlap. The following chart lists the 802.11 radio-frequency channels that are used.

Table 11. Radio Frequency Channels

Channel	Center Frequency	Frequency Spread
1	2412 MHz	2399.5 MHz - 2424.5 MHz
2	2417 MHz	2404.5 MHz - 2429.5 MHz
3	2422 MHz	2409.5 MHz - 2434.5 MHz
4	2427 MHz	2414.5 MHz - 2439.5 MHz
5	2432 MHz	2419.5 MHz - 2444.5 MHz
6	2437 MHz	2424.5 MHz - 2449.5 MHz
7	2442 MHz	2429.5 MHz - 2454.5 MHz
8	2447 MHz	2434.5 MHz - 2459.5 MHz
9	2452 MHz	2439.5 MHz - 2464.5 MHz
10	2457 MHz	2444.5 MHz - 2469.5 MHz
11	2462 MHz	2449.5 MHz - 2474.5 MHz
12	2467 MHz	2454.5 MHz - 2479.5 MHz
13	2472 MHz	2459.5 MHz - 2484.5 MHz
14	2484 MHz	2471.5 MHz – 2496.5 MHz

A.2. AUTHORIZED FREQUENCY CHANNELS BY REGION

International wireless frequency standards are a result of an IEEE 802.11WLAN committee agreement. These standards enable the wireless data communication industry to develop interoperable, low-cost, integrated equipment such as the Airborne™ Radio Module.

Authorized frequency channels vary by geographic region. The United States, Canada, Japan, Spain, France, and the ETSI, or remaining European countries, each have their own authorized frequencies.

The following table illustrates authorized channels of operation according to geographic region. Though this list is believed to be accurate at time of publication, consult local regulatory authorities before using these channels of operation.

Table 12. IEEE 802.11 Channels

Channel Number	Channel Frequency	Geographic Region
1	2412MHz	US, CA, ETSI, MKK
2	2417MHz	US, CA, ETSI, MKK
3	2422MHz	US, CA, ETSI, MKK
4	2427MHz	US, CA, ETSI, MKK
5	2432MHz	US, CA, ETSI, MKK
6	2437MHz	US, CA, ETSI, MKK
7	2442MHz	US, CA, ETSI, MKK
8	2447MHz	US, CA, ETSI, MKK
9	2452MHz	US, CA, ETSI, MKK
10	2457MHz	US, CA, ETSI, MKK, FR, SP
11	2462MHz	US, CA, ETSI, MKK, FR, SP
12	2467MHz	ETSI, FR, MKK
13	2472MHz	ETSI, FR, MKK
14	2484MHz	MKK

US = United States, CA = Canada, ETSI = European countries (except France and Spain), FR = France, SP = Spain, MKK = Japan

The Airborne™ Radio Module Firmware is FCC Compliant. You must use region-compliant firmware that restricts channel access, such as ETSI-compliant firmware. Because the end user does not have the ability to alter this firmware, regulatory compliance is ensured.

APPENDIX B: GLOSSARY

This appendix provides a glossary of wireless terminology.

802.11	Wireless standards developed by the IEEE that specify an "over-the-air" interface for wireless Local Area Networks. 802.11 is composed of several standards operating in different radio frequencies.
802.11a	802.11a is an IEEE specification for wireless networking that operates in the 5 GHz frequency range (5.725 GHz to 5.850 GHz) with a maximum 54 Mbps data transfer rate. The 5 GHz frequency band is not as crowded as the 2.4 GHz frequency, because the 802.11a specification offers more radio channels than the 802.11b/g. These additional channels can help avoid radio and microwave interference.
802.11b	802.11b is the international standard for wireless networking that operates in the 2.4 GHz frequency range (2.4 GHz to 2.4835 GHz) and provides a throughput of up to 11 Mbps.
802.11g	802.11g is similar to 802.11b, but this forthcoming standard provides a throughput of up to 54 Mbps. It also operates in the 2.4 GHz frequency band but uses OFDM radio technology in order to boost overall bandwidth.
Access Point	An interface between a wireless network and a wired network Access Points can combine with a distribution system such as Ethernet to create multiple radio cells (BSSs) that enable roaming throughout a facility.
Ad-Hoc mode	A wireless network composed of only stations and no Access Point.
Association service	An IEEE 802.11 service that an enables the mapping of a wireless station to the distribution system via an Access Point.
Asynchronous transmission	Type of synchronization where there is no defined time relationship between transmission of frames.
Authentication	The process a station uses to announce its identify to another station. IEEE 802.11 specifies two forms of authentication: open system and shared key.
Bandwidth	The amount of transmission capacity available on a network at any point in time. Available bandwidth depends on several variables such as the rate of data transmission speed between networked devices, network overhead, number of users, and the type of device used to connect PCs to a network.
Basic Service Set (BSS)	A set of 802.11-compliant stations that operate as a connected wireless network.

Bits per second (bps)	A measurement of data transmission speed over communication lines based on the number of bits that can be sent or received per second.
BSSID	Basic Service Set Identifier. A 48-bit identifier used by all stations in a BSS in frame headers. Usually MAC address.
Clear channel assessment	A function that determines the state of the wireless medium in an IEEE 802.11 network.
Client	Any computer connected to a network that requests services (files, print capability) from another member of the network.
Command Line Interface (CLI)	A method of interacting with the Airborne WLN Module by sending it typed commands.
Direct sequence spread spectrum (DSSS)	Combines a data signal at the sending station with a higher data rate bit sequence, which many refer to as a chip sequence (also known as processing gain). A high processing gain increases the signal's resistance to interference. The minimum processing gain that the FCC allows is 10, and most products operate under 20.
Disassociation service	An IEEE 802.11 term that defines the process a station or Access Point uses to notify that it is terminating an existing association.
Distribution service	An IEEE 802.11 station uses the distribution service to send MAC frames across a distribution system.
GPIO	General Purpose Input/Output refers to the digital I/O lines.
Host application	The environment within which the Module is embedded - typically includes a processor, which forms part of an OEM's product and application.
Hot spot	Same as an Access Point, usually found in public areas such as coffee shops and airports.
IEEE	Institute of Electrical and Electronic Engineers, an international organization that develops standards for electrical . The organization uses a series of numbers, like the Dewey Decimal system in libraries, to differentiate between the various technology families.
Independent Basic Service Set Network (IBSS Network)	An IEEE 802.11-based wireless network that has no backbone infrastructure and consists of at least two wireless stations. This type of network is often referred to as an Ad-Hoc network because it can be constructed quickly without too much planning.

Infrastructure mode	A client setting providing connectivity to an Access Point. As compared to Ad-Hoc mode, whereby PCs communicate directly with each other, clients set in Infrastructure mode all pass data through a central Access Point. The Access Point not only mediates wireless network traffic in the immediate neighborhood, but also provides communication with the wired network. See Ad-Hoc and AP.
LAN application	A software application that runs on a computer, which is attached to a LAN, Intranet or the Internet, and using various protocols can communicate with the Module.
Local Area Network	A system of connecting PCs and other devices within the same physical proximity for sharing resources such as Internet connections, printers, files and drives. When Wi-Fi is used to connect the devices, the system is known as a wireless LAN or WLAN.
Medium Access Control Layer	One of two sub-layers that make up the Data Link Layer of the OSI reference model. The MAC layer is responsible for moving data packets to and from one network node to another across a shared channel.
MPDU	MAC Protocol Data Unit, the unit of data exchanged between two peer MAC entities using the services of the physical layer (PHY).
MSDU	MAC Service Data Unit, information that is delivered as a unit between MAC service Access Points (SAPs).
Peer-to-peer network	A wireless or wired computer network that has no server or central hub or router. All the networked PCs are equally able to act as a network server or client, and each client computer can talk to all the other wireless computers without having to go through an Access Point or hub. However, since there is no central base station to monitor traffic or provide Internet access, the various signals can collide with each other, reducing overall performance.
RS-232	An EIA standard that specifies up to 20 Kbps, 50 foot, serial transmission between computers and peripheral devices.
RTOS	An operating system implementing components and services that explicitly offer deterministic responses, and therefore allow the creation of real-time systems. An RTOS is characterized by the richness of the services it provides, the performance characteristics of those services, and the degree that those performance characteristics can be controlled by the application engineer (to satisfy the requirements of the application).

Service Set Identifier (SSID)	An identifier attached to packets sent over the wireless LAN that functions as a "password" for joining a particular radio network (BSS). All radios and Access Points within the same BSS must use the same SSID, or their packets will be ignored.
Telnet	A virtual terminal protocol used in the Internet, enabling users to log into a remote host.
Transceiver	A device for transmitting and receiving packets between the computer and the medium.
Transmission Control Protocol (TCP)	A commonly used protocol for establishing and maintaining communications between applications on different computers. TCP provides full-duplex, acknowledged, and flow-controlled service to upper-layer protocols and applications.
Wide Area Network (WAN)	A communication system of connected PCs and other computing devices across a large local, regional, national or international geographic area. Also used to distinguish between phone-based data networks and Wi-Fi. Phone networks are considered WANs and Wi-Fi networks are considered wireless LANs.
Wi-Fi	Wirekless-Fidelity: Wi-Fi is the common name used for 802.11 wireless network technology.
Wi-Fi Alliance	A non-profit international association formed in 1999 to certify interoperability of wireless LAN products based on IEEE 802.11 specification.
Wired Equivalent Privacy (WEP)	A security protocol for wireless LANs defined in the IEEE 802.11 standard. WEP is designed to provide the same level of security as a wired LAN.
WLAN	Also referred to as a wireless LAN. A type of local-area network that uses high-frequency radio waves rather than wires to communicate between nodes and provide network connectivity.

INDEX

Vias, 19

V

QUATECH Confidential

5675 Hudson Industrial Parkway
Hudson, OH 44236
Tel: 330-655-9000
www.Quatech.com