PRISM1KIT-EVAL Wireless LAN Evaluation Kit User's Guide

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Introduction

This kit allows evaluation of the Intersil PRISM® Direct Sequence chipset and AMD PCNet Mobile MAC design in a PC Card implementation.

Software drivers are included allowing data to be transmitted between cards at a high speed, 2Mbps transfer rate, with a diagnostic program to display the real data throughput from system to system.

Included in the kit are PRISM chipset and PCNet Mobile MAC chip data sheets with application notes describing the implementation of a wireless networking card using the chipset.

Contents of Your Evaluation Kit

Your PC Card Wireless LAN Evaluation Kit may contain the following items:

QUANTITY	DESCRIPTION
2	Wireless LAN PC Cards
2	Extender Cards
1	PC Card Wireless LAN Evaluation Kit User Guide
1	Intersil Data Sheet
1	AMD Data Sheet
1	Application Note (AMD/Intersil)
1	Application Note (Intersil)
1	Features/Benefits Card
1	S/W Application Note
1	Product Registration Form

Should you discover that your PC Card Wireless LAN Evaluation Kit is incomplete, contact Intersil Corporation.

Overview of IEEE 802.11

The IEEE 802.11 specification is a standard for wireless connectivity for fixed, portable, and moving stations within a local area.

The 802.11 standard describes the services required by a compliant device to operate within an "*ad hoc"* or "infrastructure" network, as well as deal with the issues related to mobility within those networks. Spread spectrum techniques are used to tolerate mobility and multipath effects; they are also a requirement for compliance with FCC regulations when operating within the Industrial, Scientific, and Medical (ISM) frequency band.

An *ad hoc* communications network is created quickly and informally for a temporary time period. An infrastructure network usually requires more planning so that wireless stations can communicate over longer distances through access points, and may also communicate with existing wired LANs using portals.

The 802.11 standard describes Media Access Control (MAC) procedures. The principal method of communication is the Carrier Sense Multiple Access with Collision Avoidance (CSMA-CA) protocol. Using this protocol, each station senses the communications medium (RF channel), and does not transmit until the channel is clear. This avoids collisions and minimizes the retransmission of subsequent packets.

The standard also supports the operation of a station within a wireless LAN that may coexist with several overlapping wireless LANs. To accomplish this, a scheme of channelization and spread spectrum techniques is used. Direct Sequence (DSSS) and Frequency Hopping (FHSS) spread spectrum techniques are supported by the standard and both operate in the 2.4 to 2.4835GHz frequency band (the unlicensed ISM band). An infrared technique is also supported for indoor applications.

The standard has also specified the requirements and services that enable private and secure communications to occur.

Wireless LAN Configurations

For ease of use in evaluating these cards, an *ad hoc* network for peer to peer communications can be created. An *ad hoc* network is usually created for a specific purpose (such as file transfer or accessing a database). *Ad hoc* networks simplify the process of creating and dissolving networks for nontechnical users of the network facilities. Two cards form an IEEE 802.11 Independent Basic Service Set (BSS), the simplest *ad hoc* network. The cards communicate with each other directly and must remain within radio range. When both cards are on, they immediately "see" each other and the *ad hoc* network is formed without user intervention.

To use the cards in an infrastructure BSS (also called an Extended Service Set) where the two cards may not be in direct radio contact, access points are needed. To accommodate this configuration, the cards require an upgrade to the currently loaded firmware only. The association between a card (station) and an infrastructure BSS - where communication occurs only between a station and an access point and not between stations directly - is dynamic.

The IEEE 802.11 protocols are implemented in the PCNet firmware so that file transfers or database access can begin immediately.

Direct Sequence Spread Spectrum Approach

The use of spread spectrum techniques for wireless computer communications is widely accepted because of its robustness against multipath effects and interference from intentional or unintentional radiators. The use of spread spectrum techniques in the ISM frequency band also allows products to be deployed without the need for an FCC license.

The two main methods by which spread spectrum communications can be achieved are DSSS, and FHSS. This wireless LAN PC card uses the DSSS technique. Direct sequence transmission has the best performance in terms of multipath immunity and jamming rejection. In an office environment, jamming sources are likely to be unintentional such as emissions from microwave ovens. Even though unintentional, they pose a threat to the communications network. Direct sequence techniques are superior to frequency hopped systems in this case because frequency hopping gains its immunity to jamming by avoiding the location of a single tone jammer (such as other FHSS users). When collisions occur, data is lost. With a Direct Sequence system, the despreading function in the receiver gives immunity to jamming by spreading the interfering energy by the PN code over the whole bandwidth. This selective despreading attenuates the jamming power while despreading the desired signal.

In the office environment, multipath effects may degrade network communications. Direct sequence techniques offer better protection than slower frequency hopped systems in the presence of multipath interference. With frequency hopped systems, if the hopper jumps to a frequency where a null resides, then data is lost until the next hop. Multipath signals can be thought of as a special case of unintentional jamming. In the direct sequence approach, nulls resulting from multipath fading only eliminate a fraction of the signal power since the bandwidth in the DSSS case is very large. A significant amount of energy still remains in the signal and effective despreading still occurs. The probability of burst errors is reduced significantly.

An often overlooked factor when comparing IEEE 802.11 compliant direct sequence and frequency hopping implementations, is the achievable data rate. A frequency hopping occupied bandwidth of 1MHz as specified by the 802.11 standard acts as a limitation when using data rates beyond 2Mb/s. A similar bandwidth limitation has not been imposed by the 802.11 standard when using the direct sequence implementation. In actual implementations of 802.11 standard, for the same data rate (2Mb/s), the direct sequence system is more sensitive. This results in better range performance for the direct sequence approach.

Installation

Network Driver Installation

Step 1. Boot your PC under Microsoft® Windows® 95.

Step 1. Once your system has booted and is idle, insert the wireless LAN PC card (see *Hardware Installation* below).

Step 2. Microsoft Windows 95 should recognize that the card has been inserted automatically. It then displays a dialog box titled New Hardware Found. If the dialog box does not appear, run Control Panel and double click on the Add New Hardware icon.

Step 3. Insert the diskette labeled *AMD PCNet Mobile Adapter* into the floppy drive.

Step 4. Follow the on-screen instructions to install the driver.

Diagnostic Software Installation

Step 1. Insert the diagnostic Utility Diskette into the floppy drive.

Step 2. Run the A:\SETUP program from the Start button of Windows Explorer and follow the program's directions.

Hardware Installation

Step 1. Ensure that power to the PCMCIA slot is OFF.

Step 2. Insert the wireless LAN PC card extender card into the PCMCIA slot.

Step 3. Insert the wireless LAN PC card into the end of the extender card. Ensure that the antenna connector and pin headers of the extender card are on the same side. Both the card and the extender are keyed so they will fit correctly.

WARNING:
Ensure that the antenna connector on the card is terminated with a 50Ω load before powering it up. Failure to do so may result in damage to the card's power amplifier.

Acceptable 50Ω loads include a 50Ω antenna, a 50Ω RF measuring instrument, or a 50Ω RF terminating load capable of handling 100mW of power.

Extender Card Jumper Settings

All PCMCIA signals can be monitored while using the extender card. The extender card has two jumpers. Either one of these jumpers will connect the internal power plane and enable a connection between the host power and the card plugged into the extender card. The jumpers can be removed and an external power supply may be used to drive the plugged in card. Operating the extender card with both jumpers removed and no external power connected may damage the plugged in card.

PC Card Evaluation

This chapter describes several test points that may be accessed on the card.

Using the Diagnostic Utility

Instructions for using the diagnostic utilities are found in the Application Notes enclosed with this kit.

List of Test Instruments

The following instruments can be used in conducting tests on the wireless LAN PC card.

INSTRUMENT	MANUFACTURER	MODEL
Spectrum Analyzer	Hewlett-Packard	8595E
Power Meter	Giga-tronics	8541B
Signal Generator	Hewlett-Packard	8648C
Frequency Counter	Hewlett-Packard	53181A (012 Option)
Digital Scope		
General-Purpose Multimeter		
Computer with a PCMCIA Connection Slot		
Extender Card		

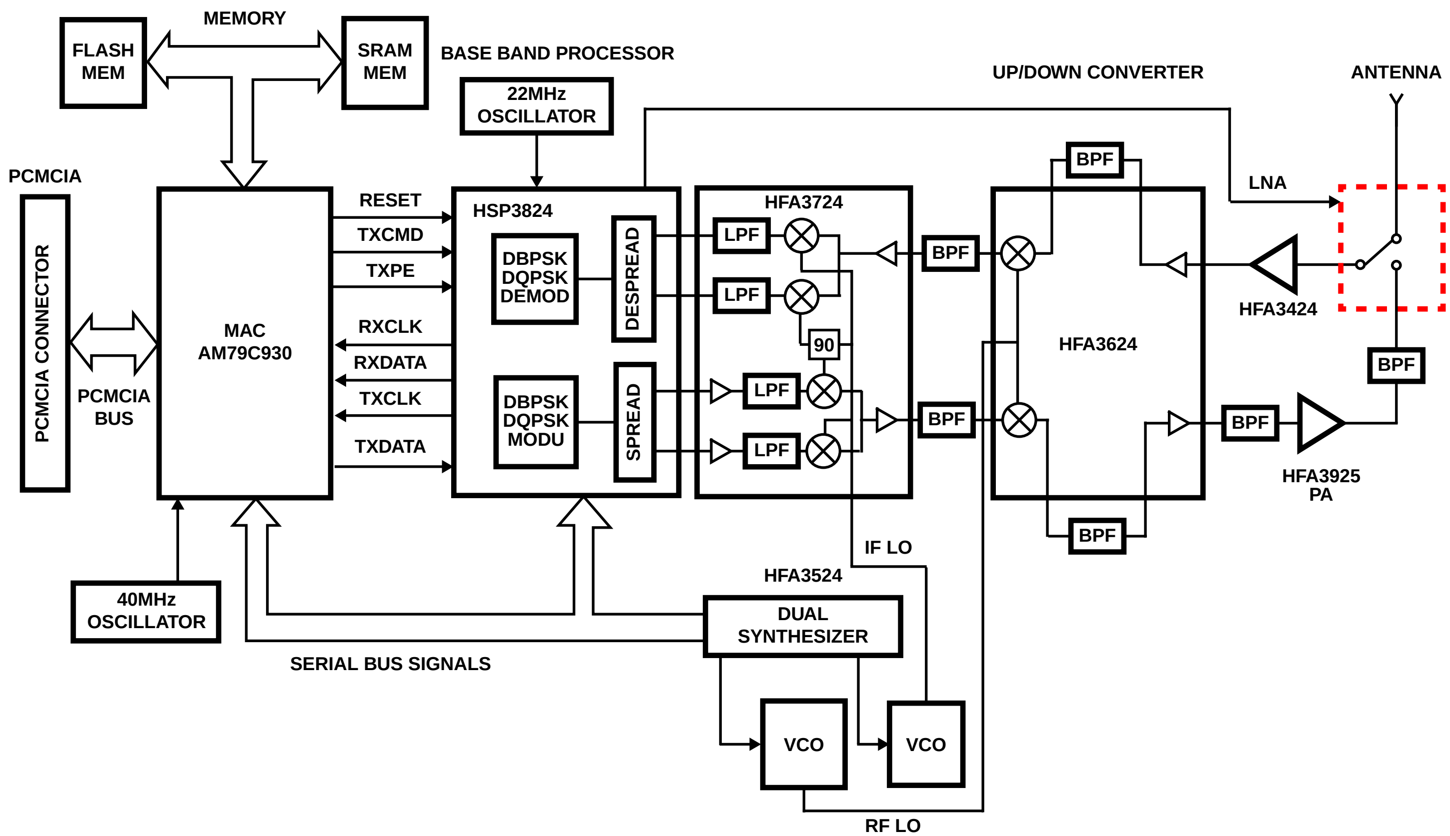

FIGURE 1. WIRELESS LAN PC CARD BLOCK DIAGRAM

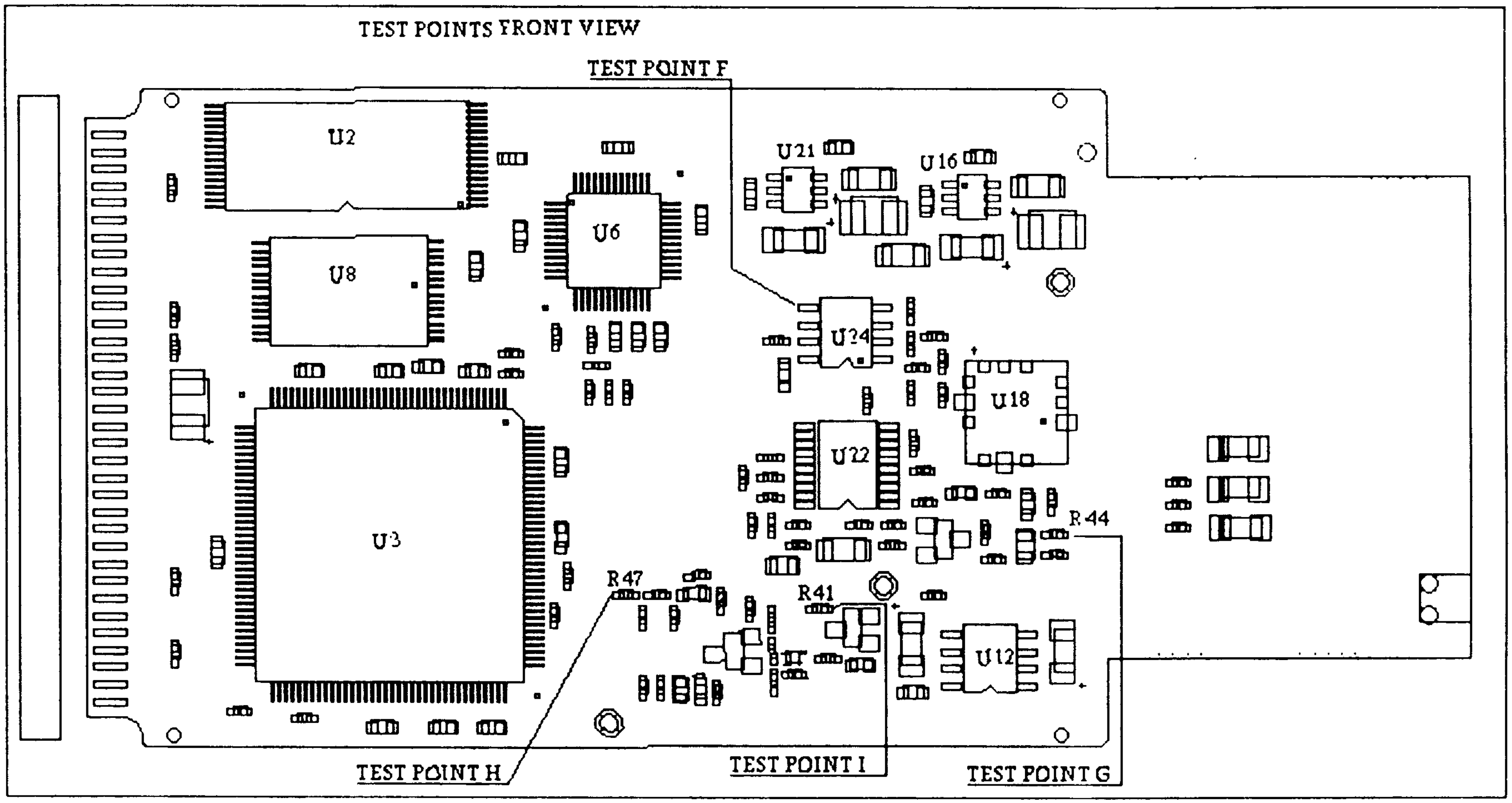

FIGURE 2. WIRELESS LAN PC CARD TEST POINTS (FRONT VIEW)

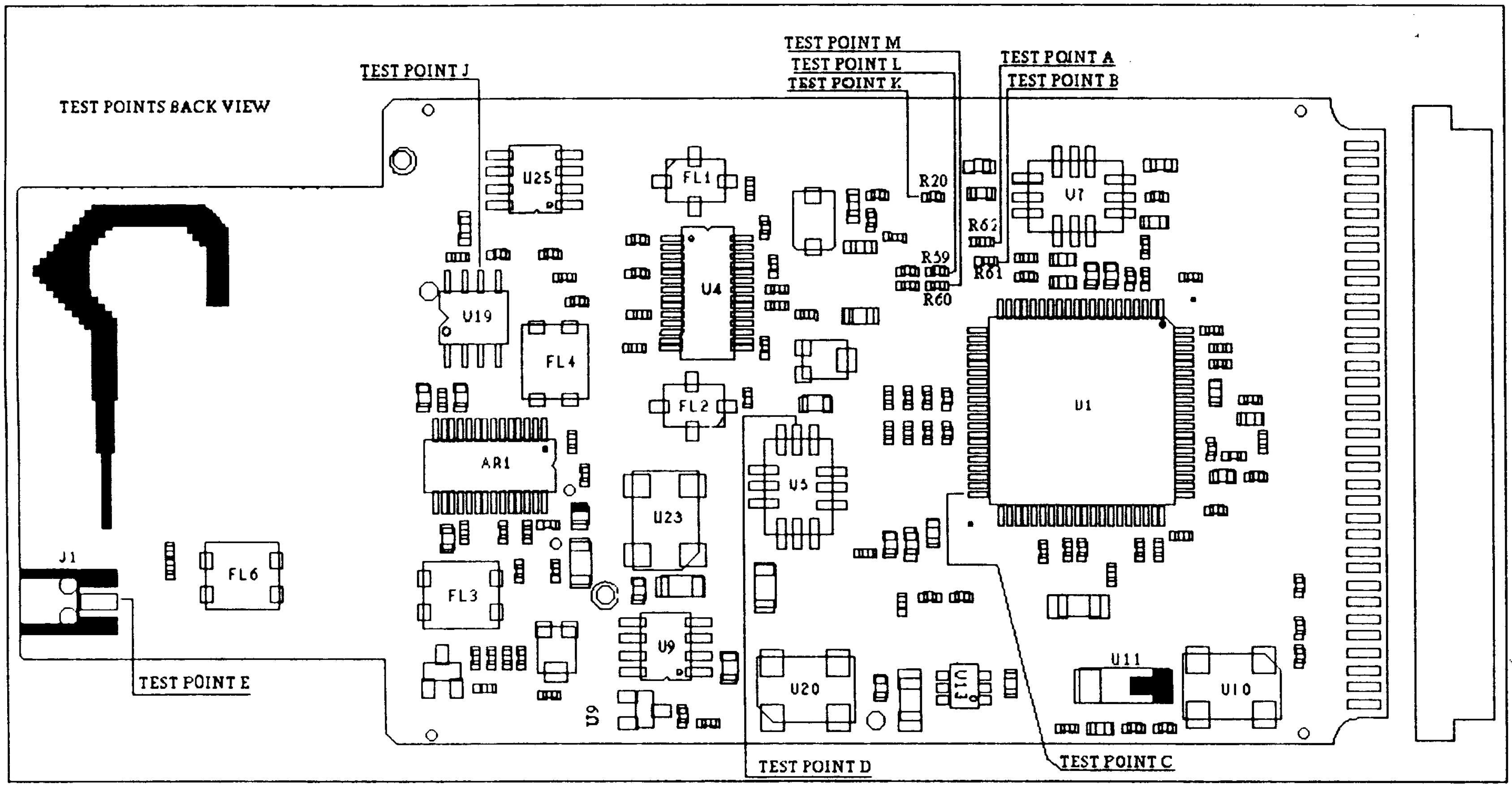

FIGURE 3. WIRELESS LAN PC CARD TEST POINTS (BACK VIEW)

Explanation of Test Points

All measurements were collected using the "Continuous Transmit" or "Continuous Receive" features of the diagnostic software. Spectrum measurements included in this section were obtained using a Hewlett-Packard 11742A probe and do not indicate the actual amplitude of the signal owing to losses associated with the probe.

Test Point A and B

Transmit I and Q:

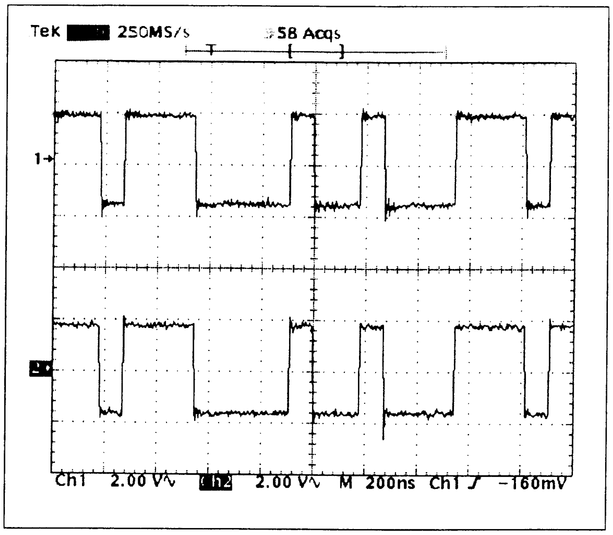

FIGURE 4. TRANSMIT I AND Q SIGNALS AT THE OUTPUT OF HFA3824 (TEST POINTS A AND B)

Note: BPSK mode is used for the plots in this figure; as such, I and Q are identical.

Transmit In-phase and Quadrature (I and Q) signals are the spread baseband single-bit I and Q digital data that are output at the programmed chip rate (N).

Transmit I and Q can be monitored through 0Ω resistors R62 and R61, respectively.

Both resistors can be removed to provide open path testing.

- Test point A for TX_I signal is at the 0Ω jumper, R62.
- Test point B for TX_Q signal is at the 0Ω jumper, R61.

Test Point C

Transmit I and Q data after shaping:

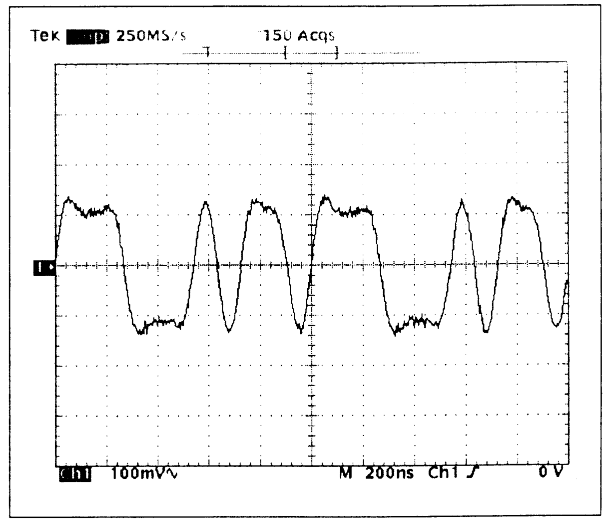

FIGURE 5. Q TRANSMITTED SIGNAL AFTER THE FIFTH ORDER BUTTERWORTH FILTER (TEST POINT C)

Both I and Q, at this point, are differential signals and have been shaped by a fifth order Butterworth filter. The test point indicated is only the negative Q transmitted data signal; this serves as an illustration of how the other signals should appear. The signal is approximately 240mV$_{P-P}$.

This test point, MODTXQ-, can be accessed on pin 40 of U1 (HFA3724).

Test Point D

IF Transmit Signal:

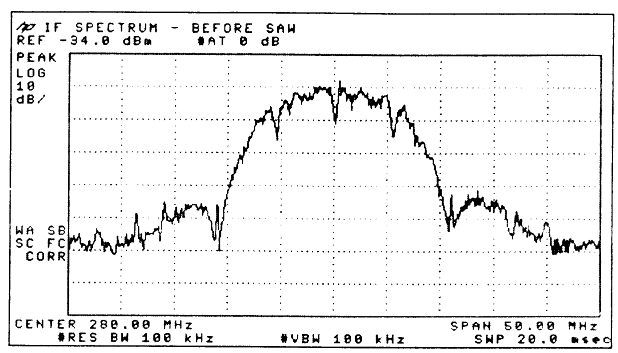

FIGURE 6. IF TRANSMIT SIGNAL BEFORE SAW FILTER

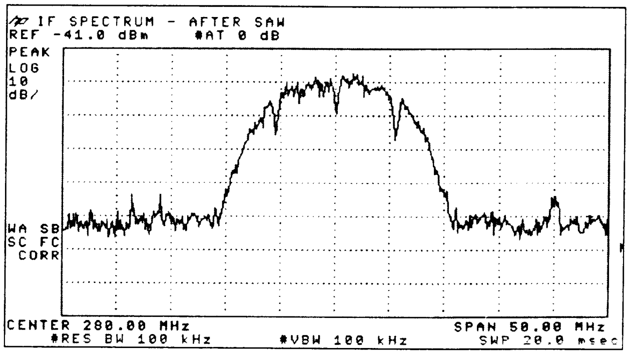

FIGURE 7. IF TRANSMIT SIGNAL AFTER THE SAW FILTER (TEST POINT D)

The intermediate frequency (IF) transmit signal is a spread spectrum signal centered at 280MHz with a 17MHz bandwidth. The peak value of the signal is typically -24dBm.

The SAW filter prior to the test point D is used to shape the sidelobes.

The test point for the TX_IF signal is at the output of the SAW filter, U5.

Test Point E

RF Transmit Signal:

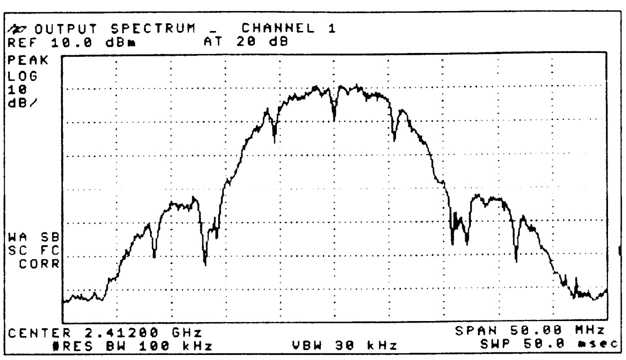

FIGURE 8. TRANSMITTED 2.4GHZ SIGNAL SPECTRUM (TEST POINT E)

The Huber Suhner connector can be used to hook up a Spectrum Analyzer for RF evaluation.

This is the up-converted spread spectrum output of the card. The center frequency of this signal is 2412-2484MHz depending on the channel of operation. The following table specifies the channels and their corresponding output center frequencies. The output power of the signal on channel one is around 18dBm. The sidelobes of the output spectrum are adjusted for -32dBr ±2dBr.

TABLE 1. COMPARISON OF THE WIRELESS LAN PC CARD CHANNEL ID TO THE FCC CHANNEL FREQUENCIES

CHANNEL ID	FCC CHANNEL FREQUENCY
1	2412MHz
2	2417MHz
3	2422MHz
4	2427MHz
5	2432MHz
6	2437MHz
7	2442MHz
8	2447MHz
9	2452MHz
10	2457MHz
11	2462MHz
12	Not Available

Test Points F and G

RF local oscillator (LO):

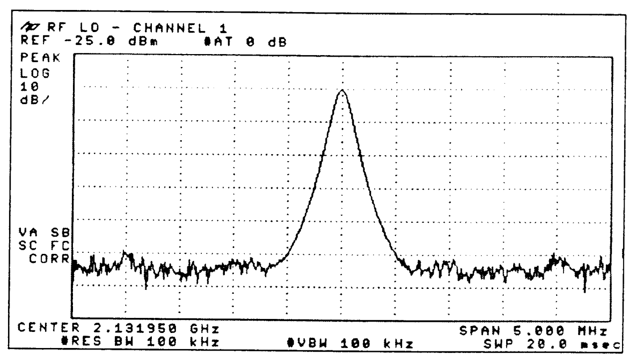

FIGURE 9. RF LOCAL OSCILLATOR OUTPUT AT CHANNEL 1 (TEST POINT F)

The behavior of the RF VCO (VCOKXN1332A), placed in the HFA3524 dual frequency synthesizer loop, can be monitored at pin 6 of the HFA3524, U24 (Test Point F).

The VCO output should be locked at the channel frequency minus the IF (280MHz.) This means that the VCO will have to lock to the two extremes of 2132MHz and 2404MHz. The output power at test point F is approximately -3dBm. This signal is attenuated by about 13dB prior to the input of the HFA3624. Ideally, the tuning voltage of VCO, when locked, falls between 0.5V to 3V. The tuning voltage of the RF VCO can be observed at one side of R44 (Test Point G).

Test Points H and I

IF local oscillator (LO):

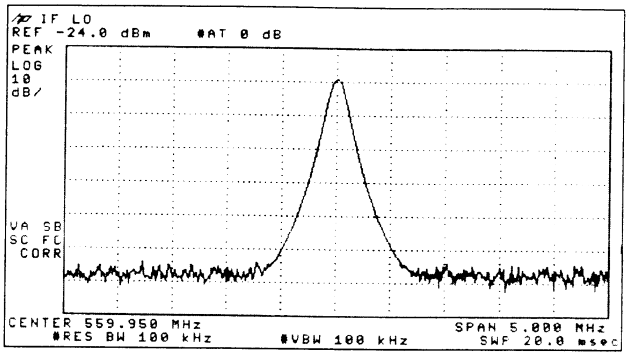

FIGURE 10. IF LOCAL OSCILLATOR OUTPUT (TEST POINT H)

The IF VCO is a discrete design and operates at 560MHz. The output frequency of this VCO does not need to be varied; thus, minimal tuning range is required.

The output frequency of this VCO can be observed at one end of R47 (Test Point H.) The output power is attenuated to -6dBm prior to the input of the HFA3724.

Ideally, the tuning voltage of the IF VCO, when locked, falls between 0.5V to 3V. The tuning voltage of the IF VCO can be observed at one side of R41 (Test Point I).

Test Point J

RF receive signal:

At this point the signal that was received at the Huber Suhner connector has been bandpass filtered and amplified. The HFA3424 amplifier is an LNA with a typical noise figure of 1.9dB and a typical gain of 14dB.

The test point for RF receive signal is pin 6 of U19.

Test Point K

IF Receive Signal:

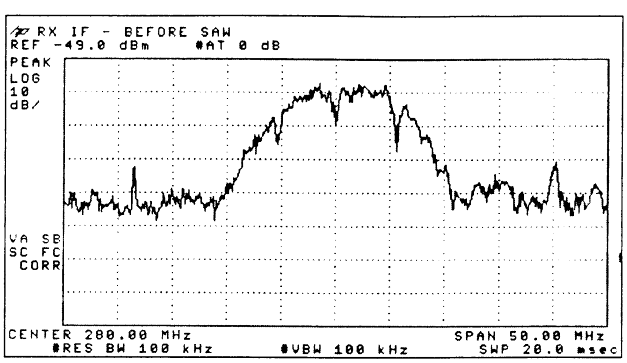

FIGURE 11. IF RECEIVE SIGNAL PRIOR TO SAW FILTER (TEST POINT K)

The intermediate frequency (IF) receive signal is the down-converted receive signal prior to the SAW bandpass filter. The RX_IF signal can be observed at either side of the 0Ω resistor R20.

The center frequency of this signal is 280MHz with a bandwidth of 17MHz. The power of this signal is directly dependent on the input signal power.

The test point for the RX_IF signal is at the 0Ω jumper, R20.

Test Point L and M

Receive I and Q:

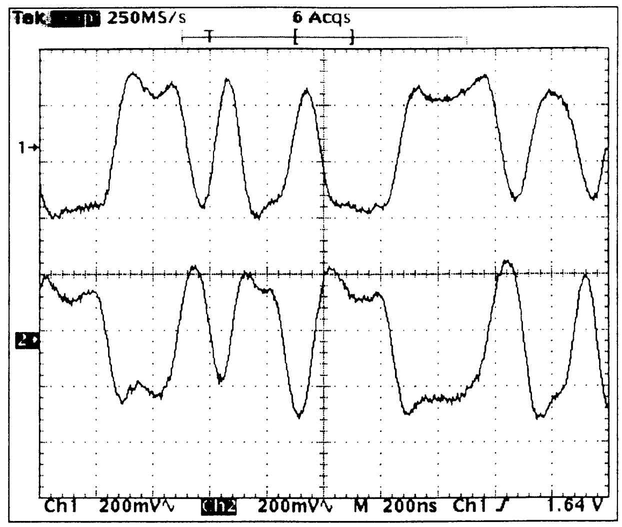

FIGURE 12. RECEIVE I AND Q SIGNALS (TEST POINTS L AND M)

Note: BPSK mode is used for the plots in this figure; as such, I and Q are inverse of each other.

The receive In-phase and Quadrature (I and Q) signals are the demodulated lowpass-filtered data that are ac-coupled to the HFA3824. The output levels of these two signals are approximately $500mV_{P-P}$.

Receive data I and Q can be monitored at 0Ω resistors R59 and R60. Both resistors can be removed to provide open path testing.

- The test point L for RX_I signal is at the 0Ω jumper, R59.
- The test point M for RX_Q signal is at the 0Ω jumper, R60.

Operational Characteristics

TABLE 2. GENERAL SPECIFICATIONS

SPECIFICATION	VALUE
Targeted Standard	IEEE 802.11
Data Rate	1Mbps DBPSK 2Mbps DQPSK
Range	400ft Indoor (Typ) 3700ft Outdoor (Typ) (Using M/A-COM ANS-C-107 Omni-Directional Antenna)
Frequency Range	2412MHz - 2484MHz
Step Size	1MHz
IF Frequency	280MHz
IF Bandwidth	17MHz
RX/TX Switching Speed	2µs (Typ)
Operating Voltage	4.5V - 5.5V DC
Standby Current	100mA at 25µs Recovery 65mA at 2ms Recovery 18mA at 15ms Recovery
Operating Temperature Range	0^oC to 55^oC
Storage Temperature Range	-20^oC to 85^oC
Mechanical	Type II PC Card, with Antenna Extension
Antenna Interface	SMA, 50Ω

TABLE 3. RECEIVE SPECIFICATIONS

SPECIFICATION	VALUE
Sensitivity	-91dBm (Typ), 1Mbps, 8E-2 FER -88dBm (Typ), 2Mbps, 8E-2 FER
Input Third Order Intercept Point	-23dBm (Min)
Image Rejection	70dB (Min)
IF Rejection	95dB (Min)
Adjacent Channel Rejection	45dB (Min)
Supply Current	280mA (Typ), 2Mbps

TABLE 4. TRANSMIT SPECIFICATIONS

SPECIFICATION	VALUE
Output Power	+18dBm (Typ)
Transmit Spectral Mask	-26dBc (Typ) at First Side-Lobe
Supply Current	460mA (Typ), 2Mbps 100% Duty Cycle

References

For Intersil documents available on the internet, see web site http://www.intersil.com/
Intersil AnswerFAX (407) 724-7800.

[1] *Application Note AN9624*, Intersil Corporation, “PRISM DSSS PC Card Wireless LAN Description,” AnswerFAX Doc. No. 99624.

[2] *Application Note AN9666*, Intersil Corporation, “Wireless LAN Evaluation Kit Software Installation and Usage,” AnswerFAX Doc. No. 99666.

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