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THIS SPEC IS OBSOLETE

Spec No: 001-15257

Spec Title: AN15257 - GUIDELINES FOR EVALUATING
SYSTEM PERFORMANCE OF CYPRESS
WIRELESSUSB(TM) RF PRODUCTS

Replaced by: NONE

Guidelines for Evaluating System Performance of Cypress WirelessUSB™ RF Products

Author: Sai Prashanth Chinnapalli

Associated Project: No

Associated Part Family: CYRF6936, CYRF6986

Software Version: NA

Related Application Notes: None

To get the latest version of this application note, or the associated project file, please visit <http://www.cypress.com/go/AN15257>.

When product designers use reference designs as a basis for their own projects, they typically modify or enhance the original designs. Unfortunately, these modifications can cause a considerable decline in performance. AN15257 describes parameters that can affect WirelessUSB™ system performance. It also explains how to evaluate these parameters within your own wireless product design.

Introduction

The rapid growth of WirelessUSB technology creates a challenge for today's wireless system designers. RF system development requires a keen understanding of RF design, circuit design, signal processing, and microcontroller technologies. Although Cypress provides complete solutions, many product designers modify these reference designs for their particular application.

When product designers make modifications, they may find that their new system does not meet performance expectations. This application note describes ways to evaluate several key parameters that can affect overall WirelessUSB system performance.

Critical RF Parameters

Some RF parameters in a wireless product design can have a major effect on performance. Make sure you verify these critical RF parameters:

- Transmit output power
- Receiver sensitivity
- Antenna impedance matching and antenna design
- Occupied bandwidth
- RF spurious and harmonic signals
- Crystal oscillator operation and accuracy
- Power supply voltage and noise
- Current consumption

- Critical component selection

Common RF Problems

Designers commonly encounter two problems in RF system designs: low wireless operating range and high data error rate. Check the following lists to see whether your product has any symptoms of these problems.

Low Wireless Operating Range

- Low transmit power
- Poor receive sensitivity
- Poor antenna impedance matching
- Poor antenna design
- Crystal oscillator offset exceeds 50 ppm
- Power supply noise
- Interference from test environment

High Data Error Rate

- Crystal oscillator offset exceeds 50 ppm
- Improper correlator threshold settings
- Power supply noise

Conducting Range Tests

If you are concerned about performance degradation in your design, start with simple range testing. This is a simple way to verify RF performance for many critical system parameters all at once.

You can implement a simple test mode in firmware that repeatedly sends packets between two devices. The receiver monitors the incoming packets and visually indicates their status. (For example, a red LED can light up each time a bad packet is received). You should test both one-way and two-way functionality. One-way testing can isolate a transmit or receive problem. More sophisticated firmware test programs can also be developed to exercise detailed radio functionality. These types of firmware are often used for regulatory testing. For information about available RF test firmware that you can use or port to a WirelessUSB system, contact Cypress.

These test environments are ideal for evaluating WirelessUSB-based radio designs:

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- Indoor chamber testing using a shielded box or room
- Anechoic chamber testing similar to an FCC test facility

Do not use test environments with characteristics that could affect test results. For example, tests conducted in an office environment can be affected by microwave ovens, Wi-Fi access points, cellular phones, and metal structures such as cubical walls.

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Range Testing Diagnostics

A WirelessUSB LP system with a power setting of PA = 7 will operate at more than 30 meters line-of-sight in a normal environment (For LPSTAR the maximum power setting PA=6). Every 6 dB increase in transmit power approximately doubles the effective range. Because a power setting of PA = 5 corresponds to a 6 dB power decrease from PA = 7, the operating distance should be approximately half for PA = 5.

You can compare the range achieved by a new system to one of the Cypress reference designs. You can then determine approximately how much link margin is missing from the new design. Because each design has different system requirements (such as packaging, antenna design, and orientation), it is common to see a variation of a few decibels between each solution. A delta of 6 dB or more probably indicates a fundamental design issue that you must address.

The range performance can be affected by several environmental factors. The human body affects the wireless link range. In the case of a wireless mouse, the user's hand placement on the mouse can significantly affect the transmit power and receiver sensitivity of the device. In this case, you should test to determine the optimum antenna location and orientation to avoid significant signal degradation from the user's hand.

Selecting Critical Components

The main critical components of the WirelessUSB system are the crystal and antenna matching discrete lumped elements. The component placement of these parts on the PCB is critical for achieving the required RF performance. Be careful if you use types and vendors other than those recommended by Cypress Semiconductor. All critical components should be of high quality and designed for the specified RF frequency application.

Crystal Oscillator

A critical system component, the crystal's accuracy requirements for the WirelessUSB Radio depend on several factors. For short-range applications, the crystal accuracy is slightly less important. The data-encoding scheme used will also impact the crystal accuracy requirements. In 32-chip-per-bit (cpb) DSSS mode, a crystal accuracy of 30 ppm or better is recommended.

However, if correlator thresholds of $L = 3$ and $H = 29$ are used instead of $L = 2$ and $H = 30$, an accuracy of 40 ppm or better can be used. In 64-cpb mode, a 50-ppm crystal spec is recommended.

Note Power supply noise and RF interference also affect the crystal accuracy requirements for reliable RF transmission.

Recommended Test Equipment

- Oscilloscope
- Frequency counter

You can verify basic crystal oscillator operation by using an oscilloscope. However, because most oscilloscopes cannot measure signal frequency accurately, you should use a frequency counter for this measurement. If the crystal frequency is not within the specified limits, investigate the cause of the problem.

To find the frequency deviation of two wireless devices, measure the crystal frequency of the oscillator for each device, and then find the difference between them.

Power Supply

Power supply voltage level and noise are very important to the RF performance of the WirelessUSB radio. Even power supplies that have been proven to work with the WirelessUSB radio can be seriously degraded when built with improperly substituted components.

WirelessUSB systems that include a switching voltage regulator can have RF performance issues. Products using a switching power supply must include a noise-filtering network on VCC Pin of the WirelessUSB QFN radio chip. The filtering network consists of a 5.1-ohm resistor in series with the VCC power supply from the switching regulator and a 10- μ F shunt capacitor to ground very close to VCC Pin.

Based on test results for various systems, it appears that peak-to-peak noise voltage of approximately 20 mV or less on VCC Pin is acceptable. To isolate power supply noise as a possible cause of an RF performance problem, it is a good idea to substitute a clean linear power supply to compare performance measurements of the whole system.

The supply voltage for the radio module should be in the range of 2.7 to 3.6 V. Operation is not guaranteed outside of this range. If the measured supply voltage is less than expected, troubleshoot the cause. The supply voltage to the radio module might come from a linear regulator or from a switching regulator. The current rating of the regulator should be at least 100 mA, and the output noise of the regulator should be less than 20 mV peak to peak.

Current Consumption

The CYRF6936 and CYRF6986 data sheets give the typical current consumption of the radio module for different modes of operation. If the measured current consumption in a particular operating mode is not the expected value, find the reason for the discrepancy because this may cause degraded performance.

Getting Accurate Measurements

When you measure the current consumption of dynamic states (such as transmit and receive), make sure you use appropriate tools. A simple current meter can read only an average current. Some more sophisticated meters can capture true peak current. Using an oscilloscope with a low-value series resistor is probably the most reliable method for monitoring the current profile of a system. Connect the resistor (approximately 1 ohm) in series with the power supplied to the radio. Use the oscilloscope to measure the voltage drop across the resistor (which you can then convert to current).

Note Only CYRF6936 has this Pin. The PACTL signal from the radio can be used as a convenient trigger source for the scope when capturing current profiles.

To measure the current consumption during power-down mode, you must use a suitable meter that resolves down to the micro-amp range. For meters that measure current by connecting them in series with the power supply, short the meter's leads together to the point at which the radio is known to be in power-down mode (to avoid damaging the meter). Measure both the current consumption of the radio and the current consumption of the overall system in power-down (sleep) mode to ensure that all of the supporting circuitry is operating as expected.

Testing Antenna Performance

For the antennas to function as efficient radiators, the antenna impedance at 2.4 GHz must be very close to 50 ohms. Practically, maintaining a VSWR of less than 1.5:1 over the entire frequency band is sufficient to ensure good performance. This corresponds to a return loss of more than 14 dB. It is important that the antenna matching be checked with the plastic enclosure or product packaging in place because the dielectric constant of the plastic can significantly lower the resonant frequency of the antenna. Additionally, the product should be tested in the target environment to verify the impact of surroundings and environment.

You can use several matching network topologies to interface with the radio chip. But cost considerations play a vital role in devising a simple matching network that can filter strong out of band signals (such as cell phones).

Antenna testing normally consists of two phases: impedance matching and radiation pattern measurement (polar plots). Impedance matching is required to deliver the maximum possible power coupling between the radio and the antenna. You typically do this by inserting a matching network into a circuit between the radio chip and the antenna, which is normally composed of inductors and capacitors. The antenna impedance and return loss measurements are made with a vector network analyzer. These measurements require significant skill, so it is recommended that an RF expert be consulted to obtain accurate measurements.

Several third-party test labs can perform radiation polar plot measurements inside an anechoic chamber. The results from this testing can show if there are any specific antenna orientation or design issues that can be corrected.

Evaluating Transmit Output Power

Transmit output power is obviously one of the most critical system parameters for achieving the desired wireless range and link robustness of the system. The output power can be degraded by several factors:

- Poor antenna design
- Improper antenna impedance match
- Circuit layout issues
- Attenuation from the product enclosure
- Improper radio register configuration
- Inadequate power supply

One method for evaluating the transmit output power is to simply compare the performance against a known-good Cypress WirelessUSB reference design. Compare the maximum operating range of a pair of Cypress reference devices to a pair of test devices. The following section describes a method for measuring the RF power output.

Recommended Test Equipment

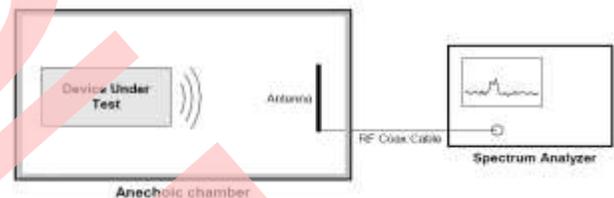
- Spectrum analyzer
- Any necessary RF coax cables, connectors, and antennas
- RF power meter (optional)
- Shielded anechoic enclosure (optional)
- RF signal generator (optional)

Measurement Setup

You can measure the transmit power of a device with a power meter or a spectrum analyzer. This procedure describes the use of a spectrum analyzer, because it is a more common piece of RF test equipment. Ideally, you should make these measurements in a shielded anechoic enclosure to avoid effects of signal reflections and external sources of interference. Alternatively, the measurements can be made in a large open area that does not contain nearby objects that can cause reflections or interference sources. Constructive and destructive signal reflections can significantly affect the power measurements.

Figure 1 shows the measurement setup for RF power output measurement. Place the device at a specific location in the test environment and make sure you carefully position the antenna. Locate the antenna of the spectrum analyzer at a fixed distance and orientation from the device. To minimize signal reflections, the only items in the anechoic test chamber should be the device and the spectrum analyzer antenna.

Figure 1. Transmit Output Power and Occupied Bandwidth Measurement Setup



Spectrum Analyzer (SA) Setup

- Connect an antenna to the input of the spectrum analyzer.
- Connect a probe to trigger when it receives the PACTL signal from the radio (optional). Set the center frequency to the desired Tx frequency.
- Set the frequency span to 10 MHz.
- Set the resolution bandwidth to 100 kHz.
- Set the Trace option to Max Hold.

Test Procedure

1. Configure the device under test into a mode where it repeatedly transmits packets, test patterns, or carrier on a desired channel.
2. Adjust the RF level and amplitude of the spectrum analyzer to get the accuracy you want.
3. Activate the Max Hold feature of the spectrum analyzer to capture the RF power output level of the signal.

- Record the RF power output level and confirm that the reading is within the acceptable range. Because it is often difficult to accurately calculate the expected power based on all of the environmental variables (such as range, antenna gain, insertion loss, radiated path loss), it is best to compare the power measurements to a known source.

To ensure reliable results, repeat the test procedure for several channels spaced throughout the frequency band. Adjust the location and orientation of the test device or antenna to find a fixed position that obtains reliable, repeatable results. Repeat the test procedure using either a Cypress reference device or an RF signal generator. Make sure you position the reference device in the exact location of the device under test.

Occupied Bandwidth

You can use the measured occupied bandwidth of a transmitted RF signal to evaluate the quality of the eye pattern. To help ensure a good quality transmit eye, the -20 dB occupied bandwidth must be <1.7 MHz.

Measurement Setup

The recommended test environment for the occupied bandwidth measurement is the same as that used for the RF power output measurement described earlier and shown in Figure 1.

Spectrum Analyzer (SA) Setup

- Trigger upon receiving the PACTL signal from the radio (optional).
- Set the center frequency to the Tx frequency.

Note Depending on transmit packet timing and the sweep speed of the SA, part of the signal may appear to be cut off. To compensate for this, shift the frequency over to avoid the cutoff point.)

- Set the frequency span to 10 MHz.
- Set the resolution bandwidth to 100 kHz.
- Set the Ref level so that the signal peak is near the top of the screen. **Note** The absolute amplitude is irrelevant when making the occupied bandwidth measurement.
- Configure the Trace menu to Max Hold.

Test Procedure

- Press Peak Search to find the exact frequency at the peak of the signal.
- Use the markers to find the frequency offset where the signal is 20 dB lower than the peak (the spectrum should be fairly symmetrical).
- The occupied bandwidth measurement is simply double the frequency offset between the peak and the -20 dB point.

The measured bandwidth value should be <1.7 MHz. Some possible causes for a poor transmit eye (higher occupied bandwidth) include:

- Noisy power supply
- Poorly designed external amplifier.

Receiver Sensitivity

Receiver sensitivity is an important parameter for longer-range applications. It is important to note that receiver sensitivity is less important in environments that have a significant amount of interference. If you require good long-range performance, you should carefully evaluate the system's receiver sensitivity.

You can use a variety of techniques to evaluate receiver sensitivity. Range testing (as described earlier in this document) is a good first step to determine if there is a potential receiver problem. Because accurate receiver sensitivity measurements require sophisticated test equipment and techniques, it is recommended that a simpler comparison test be performed against a known-good Cypress reference design.

Recommended Test Equipment

- Anechoic shielded enclosure
- RF coax cables, connectors, and antennas
- Variable step attenuators

Measurement Setup

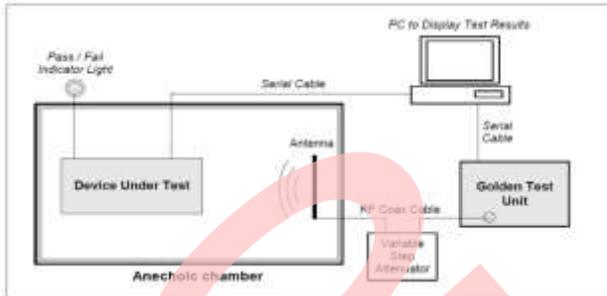
Some test firmware is required to perform this test. The firmware must send test packets from a golden test unit to the device under test. The device must have a way to indicate an approximate packet error rate of the received packets. This can be achieved in several ways:

- Wireless loopback of the received packets
- Serial debug output indicating error rate
- Simple pass/fail LED on the device

The general concept for this test is to attenuate the signal from the golden test unit to the point where the error rate of the device receiver exceeds a desired threshold. The signal strength (based on the attenuation setting) at this point determines the sensitivity level.

Figure 2 shows the measurement setup for receive sensitivity evaluation (optional items appear in italics in the figure).

Figure 2. Receiver Sensitivity Measurement Setup



Test Procedure

1. Place the device under test into an anechoic chamber so that interference and signal reflections do not affect the test.
2. Connect any additional instrumentation required to evaluate the received packet error rate on the device (such as a serial data cable).
3. Activate the required test firmware on the device.
4. Carefully position the golden transmit antenna in the anechoic chamber.
5. Close the anechoic chamber.
6. Activate the test firmware on the golden radio module.
7. Slowly increase the attenuator setting to the point at which the device indicates that the error rate threshold has been reached.

8. Record the relative receive-sensitivity level (based on the attenuator setting). This does not indicate the absolute receive sensitivity. Several additional factors, such as transmit power, insertion loss, and antenna gain, would have to be included to calculate the absolute sensitivity.
9. Repeat the test procedure with a known-good reference design for the device. Compare the relative sensitivity of the device against the reference design to determine if the receive sensitivity of the new design meets the performance of the reference design.

Summary

This application note provides general guidance for evaluating the RF performance of a new system. Start with simple range testing to determine whether your design has a performance issue that requires further investigation.

About the Author

Name: Sai Prashanth Chinnapalli.
 Title: Applications Engineer Staff

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B	3201487	KKCN	03/03/2011	Added CYRF6986 information to the file. Replaced 'LP' with 'LPstar' in the content.
*C	3369179	CSAI	09/13/2011	No change. Completing Sunset Review.
*D	4519783	CSAI	09/30/2014	Updated to new template. Completing Sunset Review.
*E	5839083	AESATMP9	07/31/2017	Updated logo and copyright.
*F	5930488	ANKC	10/16/2017	Obsoleting the spec

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Getting Accurate Measurements

When you measure the current consumption of dynamic states (such as transmit and receive), make sure you use appropriate tools. A simple current meter can read only an average current. Some more sophisticated meters can capture true peak current. Using an oscilloscope with a low-value series resistor is probably the most reliable method for monitoring the current profile of a system. Connect the resistor (approximately 1 ohm) in series with the power supplied to the radio. Use the oscilloscope to measure the voltage drop across the resistor (which you can then convert to current).

Note Only CYRF6936 has this Pin. The PACTL signal from the radio can be used as a convenient trigger source for the scope when capturing current profiles.

To measure the current consumption during power-down mode, you must use a suitable meter that resolves down to the micro-amp range. For meters that measure current by connecting them in series with the power supply, short the meter's leads together to the point at which the radio is known to be in power-down mode (to avoid damaging the meter). Measure both the current consumption of the radio and the current consumption of the overall system in power-down (sleep) mode to ensure that all of the supporting circuitry is operating as expected.

Testing Antenna Performance

For the antennas to function as efficient radiators, the antenna impedance at 2.4 GHz must be very close to 50 ohms. Practically, maintaining a VSWR of less than 1.5:1 over the entire frequency band is sufficient to ensure good performance. This corresponds to a return loss of more than 14 dB. It is important that the antenna matching be checked with the plastic enclosure or product packaging in place because the dielectric constant of the plastic can significantly lower the resonant frequency of the antenna. Additionally, the product should be tested in the target environment to verify the impact of surroundings and environment.

You can use several matching network topologies to interface with the radio chip. But cost considerations play a vital role in devising a simple matching network that can filter strong out of band signals (such as cell phones).

Antenna testing normally consists of two phases: impedance matching and radiation pattern measurement (polar plots). Impedance matching is required to deliver the maximum possible power coupling between the radio and the antenna. You typically do this by inserting a matching network into a circuit between the radio chip and the antenna, which is normally composed of inductors and capacitors. The antenna impedance and return loss measurements are made with a vector network analyzer. These measurements require significant skill, so it is recommended that an RF expert be consulted to obtain accurate measurements.

Several third-party test labs can perform radiation polar plot measurements inside an anechoic chamber. The results from this testing can show if there are any specific antenna orientation or design issues that can be corrected.

Evaluating Transmit Output Power

Transmit output power is obviously one of the most critical system parameters for achieving the desired wireless range and link robustness of the system. The output power can be degraded by several factors:

- Poor antenna design
- Improper antenna impedance match
- Circuit layout issues
- Attenuation from the product enclosure
- Improper radio register configuration
- Inadequate power supply

One method for evaluating the transmit output power is to simply compare the performance against a known-good Cypress WirelessUSB reference design. Compare the maximum operating range of a pair of Cypress reference devices to a pair of test devices. The following section describes a method for measuring the RF power output.

Recommended Test Equipment

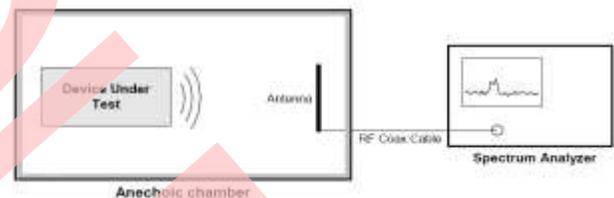
- Spectrum analyzer
- Any necessary RF coax cables, connectors, and antennas
- RF power meter (optional)
- Shielded anechoic enclosure (optional)
- RF signal generator (optional)

Measurement Setup

You can measure the transmit power of a device with a power meter or a spectrum analyzer. This procedure describes the use of a spectrum analyzer, because it is a more common piece of RF test equipment. Ideally, you should make these measurements in a shielded anechoic enclosure to avoid effects of signal reflections and external sources of interference. Alternatively, the measurements can be made in a large open area that does not contain nearby objects that can cause reflections or interference sources. Constructive and destructive signal reflections can significantly affect the power measurements.

Figure 1 shows the measurement setup for RF power output measurement. Place the device at a specific location in the test environment and make sure you carefully position the antenna. Locate the antenna of the spectrum analyzer at a fixed distance and orientation from the device. To minimize signal reflections, the only items in the anechoic test chamber should be the device and the spectrum analyzer antenna.

Figure 1. Transmit Output Power and Occupied Bandwidth Measurement Setup



Spectrum Analyzer (SA) Setup

- Connect an antenna to the input of the spectrum analyzer.
- Connect a probe to trigger when it receives the PACTL signal from the radio (optional). Set the center frequency to the desired Tx frequency.
- Set the frequency span to 10 MHz.
- Set the resolution bandwidth to 100 kHz.
- Set the Trace option to Max Hold.

Test Procedure

1. Configure the device under test into a mode where it repeatedly transmits packets, test patterns, or carrier on a desired channel.
2. Adjust the RF level and amplitude of the spectrum analyzer to get the accuracy you want.
3. Activate the Max Hold feature of the spectrum analyzer to capture the RF power output level of the signal.

- Record the RF power output level and confirm that the reading is within the acceptable range. Because it is often difficult to accurately calculate the expected power based on all of the environmental variables (such as range, antenna gain, insertion loss, radiated path loss), it is best to compare the power measurements to a known source.

To ensure reliable results, repeat the test procedure for several channels spaced throughout the frequency band. Adjust the location and orientation of the test device or antenna to find a fixed position that obtains reliable, repeatable results. Repeat the test procedure using either a Cypress reference device or an RF signal generator. Make sure you position the reference device in the exact location of the device under test.

Occupied Bandwidth

You can use the measured occupied bandwidth of a transmitted RF signal to evaluate the quality of the eye pattern. To help ensure a good quality transmit eye, the -20 dB occupied bandwidth must be <1.7 MHz.

Measurement Setup

The recommended test environment for the occupied bandwidth measurement is the same as that used for the RF power output measurement described earlier and shown in Figure 1.

Spectrum Analyzer (SA) Setup

- Trigger upon receiving the PACTL signal from the radio (optional).
- Set the center frequency to the Tx frequency.

Note Depending on transmit packet timing and the sweep speed of the SA, part of the signal may appear to be cut off. To compensate for this, shift the frequency over to avoid the cutoff point.)

- Set the frequency span to 10 MHz.
- Set the resolution bandwidth to 100 kHz.
- Set the Ref level so that the signal peak is near the top of the screen. **Note** The absolute amplitude is irrelevant when making the occupied bandwidth measurement.
- Configure the Trace menu to Max Hold.

Test Procedure

- Press Peak Search to find the exact frequency at the peak of the signal.
- Use the markers to find the frequency offset where the signal is 20 dB lower than the peak (the spectrum should be fairly symmetrical).
- The occupied bandwidth measurement is simply double the frequency offset between the peak and the -20 dB point.

The measured bandwidth value should be <1.7 MHz. Some possible causes for a poor transmit eye (higher occupied bandwidth) include:

- Noisy power supply
- Poorly designed external amplifier.

Receiver Sensitivity

Receiver sensitivity is an important parameter for longer-range applications. It is important to note that receiver sensitivity is less important in environments that have a significant amount of interference. If you require good long-range performance, you should carefully evaluate the system's receiver sensitivity.

You can use a variety of techniques to evaluate receiver sensitivity. Range testing (as described earlier in this document) is a good first step to determine if there is a potential receiver problem. Because accurate receiver sensitivity measurements require sophisticated test equipment and techniques, it is recommended that a simpler comparison test be performed against a known-good Cypress reference design.

Recommended Test Equipment

- Anechoic shielded enclosure
- RF coax cables, connectors, and antennas
- Variable step attenuators

Measurement Setup

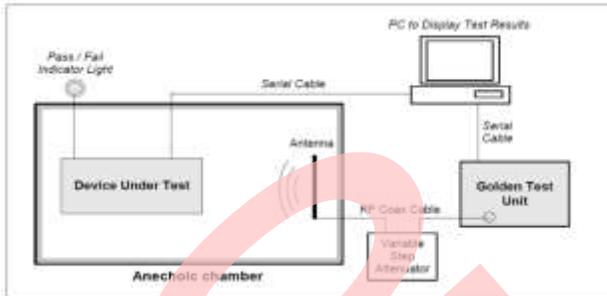
Some test firmware is required to perform this test. The firmware must send test packets from a golden test unit to the device under test. The device must have a way to indicate an approximate packet error rate of the received packets. This can be achieved in several ways:

- Wireless loopback of the received packets
- Serial debug output indicating error rate
- Simple pass/fail LED on the device

The general concept for this test is to attenuate the signal from the golden test unit to the point where the error rate of the device receiver exceeds a desired threshold. The signal strength (based on the attenuation setting) at this point determines the sensitivity level.

Figure 2 shows the measurement setup for receive sensitivity evaluation (optional items appear in italics in the figure).

Figure 2. Receiver Sensitivity Measurement Setup



Test Procedure

1. Place the device under test into an anechoic chamber so that interference and signal reflections do not affect the test.
2. Connect any additional instrumentation required to evaluate the received packet error rate on the device (such as a serial data cable).
3. Activate the required test firmware on the device.
4. Carefully position the golden transmit antenna in the anechoic chamber.
5. Close the anechoic chamber.
6. Activate the test firmware on the golden radio module.
7. Slowly increase the attenuator setting to the point at which the device indicates that the error rate threshold has been reached.

8. Record the relative receive-sensitivity level (based on the attenuator setting). This does not indicate the absolute receive sensitivity. Several additional factors, such as transmit power, insertion loss, and antenna gain, would have to be included to calculate the absolute sensitivity.
9. Repeat the test procedure with a known-good reference design for the device. Compare the relative sensitivity of the device against the reference design to determine if the receive sensitivity of the new design meets the performance of the reference design.

Summary

This application note provides general guidance for evaluating the RF performance of a new system. Start with simple range testing to determine whether your design has a performance issue that requires further investigation.

About the Author

Name: Sai Prashanth Chinnapalli.
 Title: Applications Engineer Staff

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*A	3176399	CSAI	02/17/2011	Changed name. Updated template.
B	3201487	KKCN	03/03/2011	Added CYRF6986 information to the file. Replaced 'LP' with 'LPstar' in the content.
*C	3369179	CSAI	09/13/2011	No change. Completing Sunset Review.
*D	4519783	CSAI	09/30/2014	Updated to new template. Completing Sunset Review.
*E	5839083	AESATMP9	07/31/2017	Updated logo and copyright.
*F	5930488	ANKC	10/16/2017	Obsoleting the spec

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