Anritsu Advancing beyond

Wireless LAN Product Evaluation Guide

After Commercial Release

Wireless Connectivity Test Set MT8862A

Table of Contents

1. Introduction 2

2. Evaluation Before Commercialization 2

3. Evaluation After Commercial Release 3

3.1 Basic Knowledge of Test Methods 3

3.2 Evaluation at Mass Production 3

3.3 Regression Testing 3

3.4 Quality Improvement Examples 3

3.4.1 Self-interference 4

3.4.2 USB 3.0 5

3.4.3 Maximum Output Power at Connection 5

3.4.4 WLAN Performance Characteristics in In-vehicle Networks 6

4. Test Equipment for Evaluating WLAN RF Performance 7

4.1 Research and Development 7

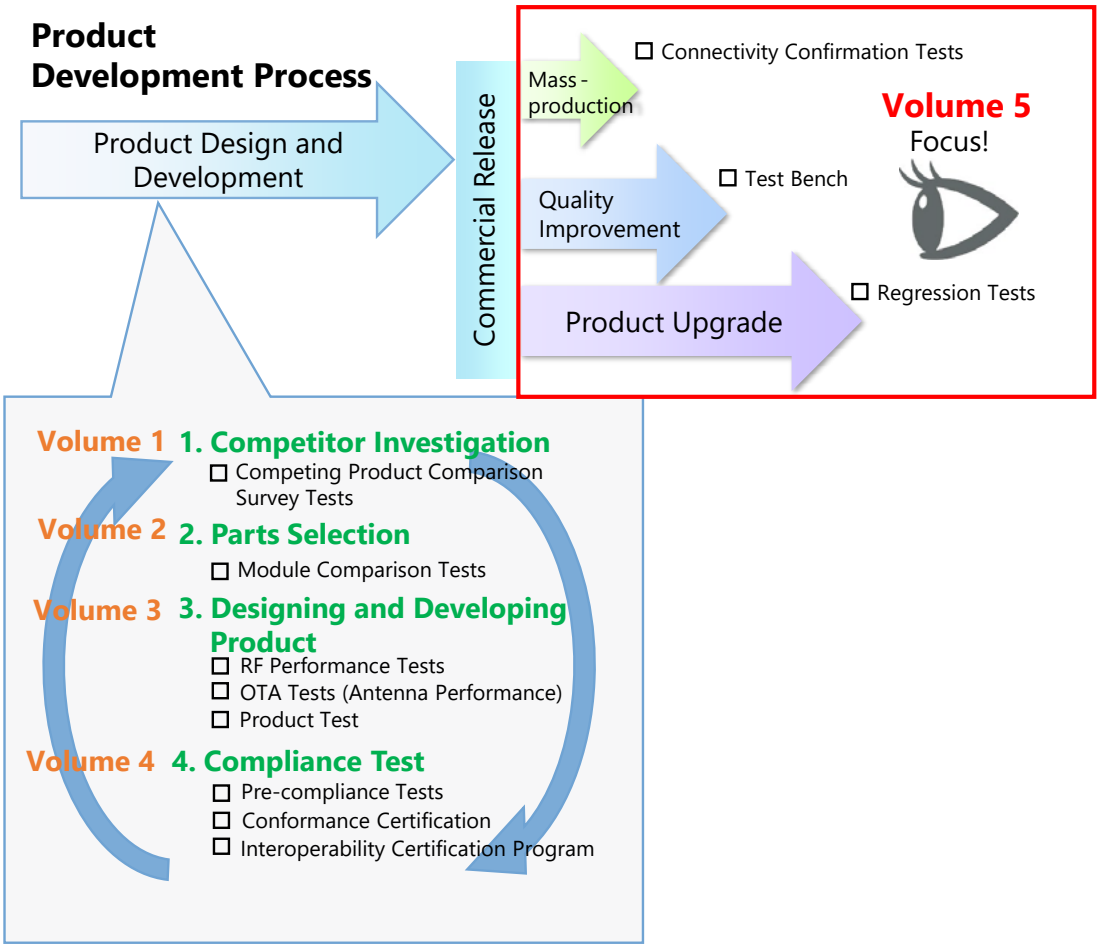
4.2 Small-Scale Manufacturing 7

4.3 Large-Scale Manufacturing/Production Line Testing 7

5. Conclusion 9

1. Introduction

This product evaluation guide was developed to help engineers starting to implement wireless LAN (WLAN) technology to connect their products to the Internet. This guide describes the RF performance evaluation that is still required after commercialization and also introduces the test equipment used at each phase, from initial development to commercialization. Even after a product is commercialized, evaluation is still necessary.



2. Evaluation Before Commercialization

Products pass through various processes before commercial release. Objective, quantified, and concrete evaluation results are obtained by measuring the signal quality and receiver sensitivity of the wireless LAN at each step of the process, enabling smooth development with less rework.

On Volume 1 ･･･ WLAN Product Evaluation Guide ～Competitor Investigation～

explained basic knowledge about WLAN standards as well as methods for comparing WLAN performance.

On Volume 2 ･･･ WLAN Product Design Guide ～Parts Selection～

Explained evaluation points for WLAN module installation as well as recommended methods for evaluating its performance.

On Volume 3 ･･･ WLAN Product Evaluation Guide ～Product Design and Development Volume～

Explained the various RF performance evaluation items and contents.

On Volume 4 ･･･ Wireless LAN Product Evaluation Guide ～Certification Guide～

Explained the certification testing required to sell completed WLAN products in the commercial market.

3. Evaluation After Commercial Release

After passing through each stage of the development process, products are prepared for release to the commercial market. However, even after commercial release of products with assured stability, it is still necessary to evaluate WLAN RF performance from various aspects, such as troubleshooting complaints. There are various tests to improve product quality and this section introduces some of the examples of these test methods.

3.1 Basic Knowledge of Test Methods

Understanding the necessary test methods for each step in the process is key in facilitating the optimum evaluation. There are two test methods using WLAN test equipment:

1. Network mode
2. Direct mode

Usually, when connecting a WLAN product to an access point (AP), a connection is established by exchanging signaling messages with the AP. This network mode or signaling mode is a test method using the same connection method as WLAN products in actual connection process. In contrast, the direct non-signaling mode tests WLAN product by transitioning to a special test mode and does not require establishing a connection link between the test equipment and WLAN product. Using either the network mode or direct mode, depending on where you are in the process, helps cut costs and improve the quality of your WLAN products.

3.2 Evaluation at Mass Production

After prototyping or a mass production pilot, following product development, in most cases manufacturing shifts to mass production where calibrating and verifying the performance of each WLAN product ensures consistent quality. These processes require a fixed amount of time for measurement, but since shorter test time relates directly to product cost competitiveness, it is important to cut test time as much as possible. Usually, the calibration does not require signaling mode, and it is commonly performed along with verification using the non-signaling method. However, depending on requirements, shipping inspections are sometimes performed in the signaling mode because WLAN products in the non-signaling mode can perform differently from the actual product use.

3.3 Regression Testing

Today's WLAN products include complex and advanced software. As a result, even if the hardware does not change, designers must still consider the risk of unforeseen changes in the RF performance when updating firmware and software. Regression testing is a useful method for reducing these risks. Post-release bugs and product recalls can be prevented by verification using regression testing to confirm there are no changes in RF performance at firmware and software updates. Regression testing does not require special tests and all items are retested at firmware and software updates in the development phase.

For example, IEEE802.11 standard and CTIA/OTA items are tested again, with the items that might be affected by the update.

WLAN Product Evaluation Guide: Product Design and Development

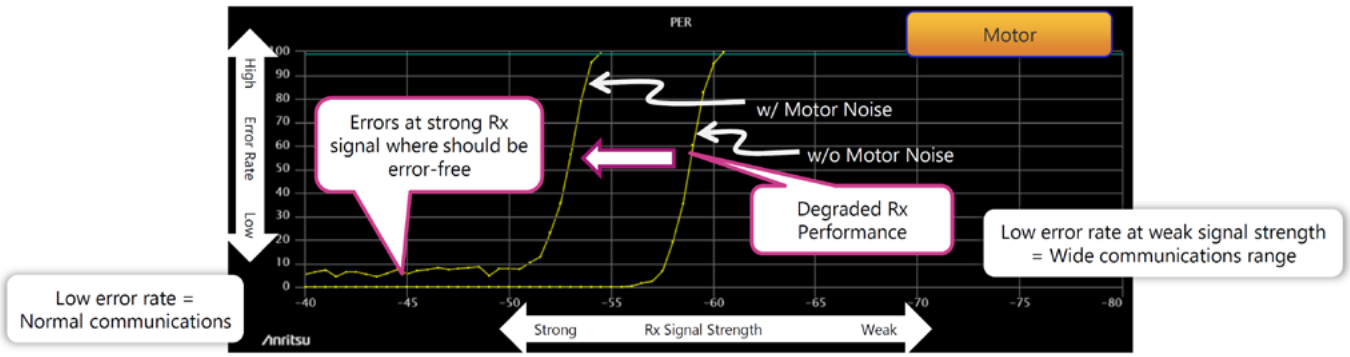
3.4 Quality Improvement Examples

Evaluation methods for improving product quality are not determined just by the standards and specifications. There are various tests and evaluations based on previously identified faults, as well as the need to evaluate the performance of WLAN products from various perspectives. The Following are some typical examples of tests and evaluations for quality improvement.

3.4.1 Self-interference

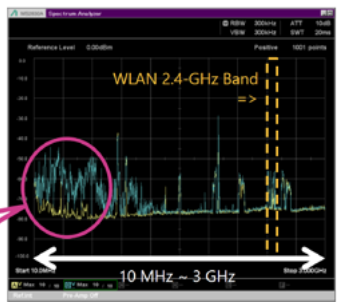
Manufacturers of products with built-in WLAN modules commonly receive customer complaints, such as “it’s difficult to connect”, “the connection gets dropped”, and “Poor coverage area”. TRx performance of the “wireless LAN module” itself should be guaranteed, but are you checking TRx performance of the finished product after installing the commercial WLAN module?

One possible cause for these complaints is “Self-interference” caused by electronic noise generated by the power supply, CPU, and motors in the finished WLAN product. Interference from noise sources in the finished product can degrade the commercial WLAN module TRx performance. Consequently, you can improve the quality of your finished WLAN product by reducing the noise components that degrade quality.



Motor Noise Confirmation Screen

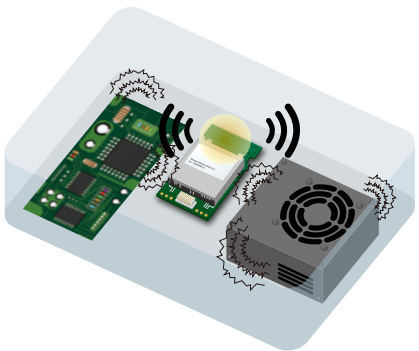
The figure on the right shows an example of a spectrum analyzer screen confirming noise generated by a motor.
Yellow: Steady State
Blue: With Motor Running



Reference Leaflet: Do your WLAN products have poor connection (called drop) problems?

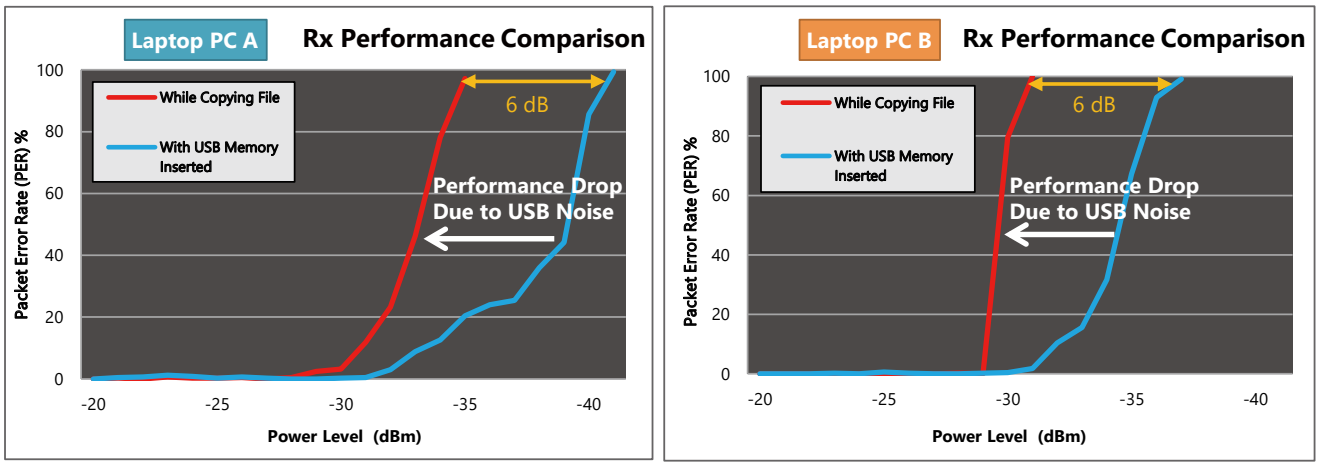
What is Self-interference?

As products become smaller, the physical separation between parts on circuit boards also becomes smaller, making it difficult to take effective conventional shielding measures against RF interference. In addition, faster CPUs, power-supply inverters, and motors in cooling fans produce RF interference (noise) to adversely affect WLAN communications. Noise generated in these products cause faults in the WLAN communications as a form of “Self-Interference”.



3.4.2 USB 3.0

USB was developed as a wired communications standard with a maximum speed of 12 Mbps for use by devices such as the mouse and keyboard, and the widespread adoption of USB led to increasing market demand for higher speeds. However, the USB signal is one cause of interference in wireless communications using the 2.4-GHz band, especially WLAN. The recent USB 3.2 Gen1 standard uses a frequency of 2.5 GHz for digital transmission to achieve high speeds of 5 Gbps. With proper design and sufficient evaluation and countermeasures, this signal does not leak from the USB interface, but as shown in the figure below, there are reports of it leaking as noise in the 2.4-GHz band. This issue can be checked either by measuring noise with a spectrum analyzer, or by measuring the Rx sensitivity with a WLAN tester.

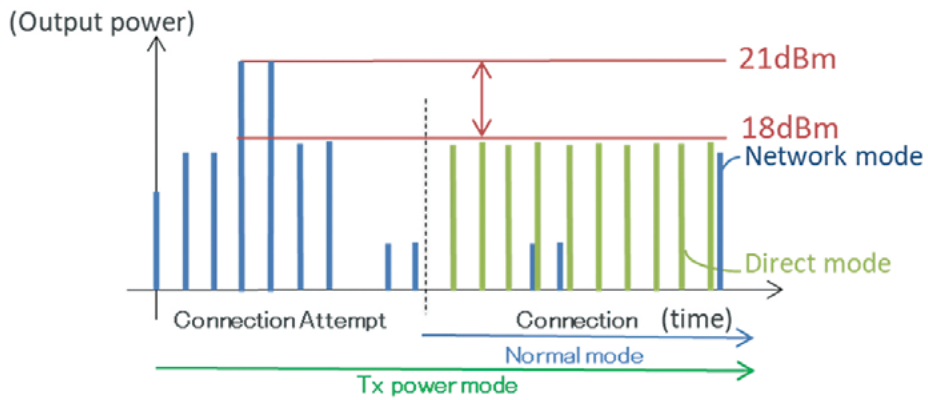


Reference Leaflet: WLAN Devices Issues with Poor Sensitivity USB Noise

3.4.3 Maximum Output Power at Connection

Wireless LANs are restricted by radio regulations defining the maximum output power. However, in many cases, the regulatory test measures the output signal in a special test mode that differs from the status at actual use. For this reason, even products that have passed the regulatory tests may have problems related to output power after commercial release.

With WLAN products, the test trend is to output signaling messages at the maximum power when establishing the connection, which requires the signaling mode to discover the excess power output.

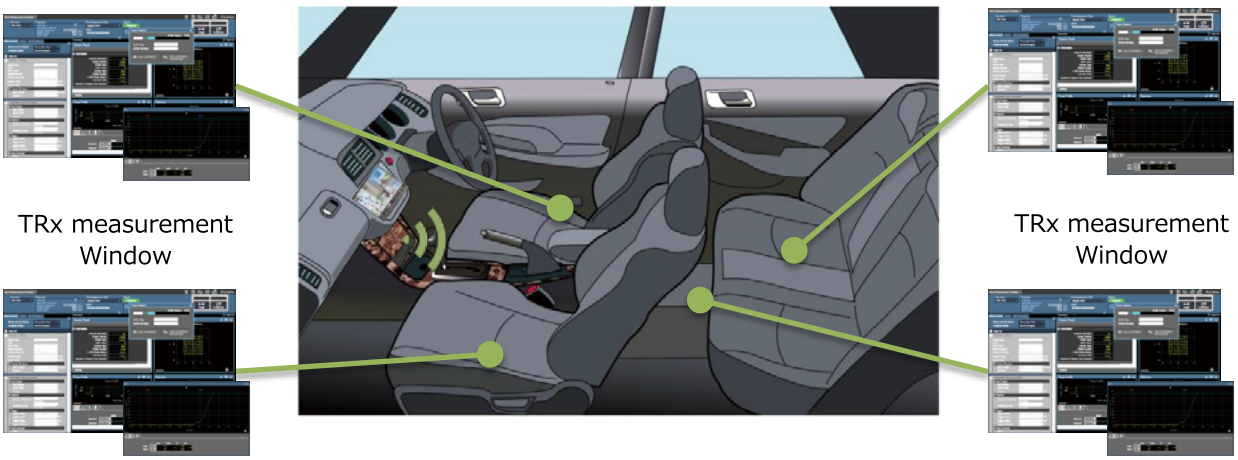


Example of Abnormal Output

Reference Leaflet: Unknowingly Transmitting Abnormal Output?

3.4.4 WLAN Performance Characteristics in In-vehicle Networks

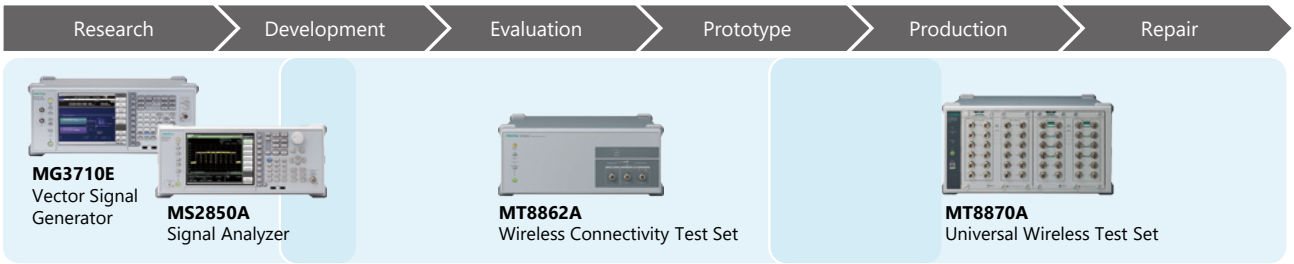
In addition to use in the workplace and home, WLAN products are a key component of in-vehicle network services, such as entertainment systems. Consequently, performance in the actual vehicle usage environment must be tested and evaluated.



Reference Leaflet: Receiving WLAN Signal Everywhere in Cabin?

4. Test Equipment for Evaluating WLAN RF Performance at Each Step of the Process

So far, this WLAN Product Evaluation Guide has centered on explaining the basics about WLAN technology and evaluation methods. This section focuses on introducing the suitable WLAN test equipment for evaluating performance, with essential features for each step of the product commercialization process.



4.1 Research and Development

Vector Signal/Spectrum Analyzer & Vector Signal Generator: MS2830A and MG3710E

The vector signal analyzer/spectrum analyzer and signal generator are general-purpose test equipment for evaluating TRx performance of various wireless equipment, including WLAN device. Both products use the non-signaling mode to confirm unwanted signals as well as to analyze modulation signals output from the wireless equipment by using test software. The signal generator confirms the product performance impact by inputting either signals following the required standards or interference signals to wireless equipment. This general purpose test equipment is commonly used at the research and initial development phases.

Product Details: MS2830A product page, MG3710E product page

4.2 Small-Scale Manufacturing

Wireless Connectivity Test Set MT8862A

The Wireless Connectivity Test Set MT8862A is a dedicated instrument for WLAN and supports the signaling mode and non-signaling mode for a wide range of tests. Tests using the signaling mode do not require switching to the special test mode for evaluation testing and have a wide application range from development to small-scale mass-production due to easy connection.

Product Details: MT8862A product page

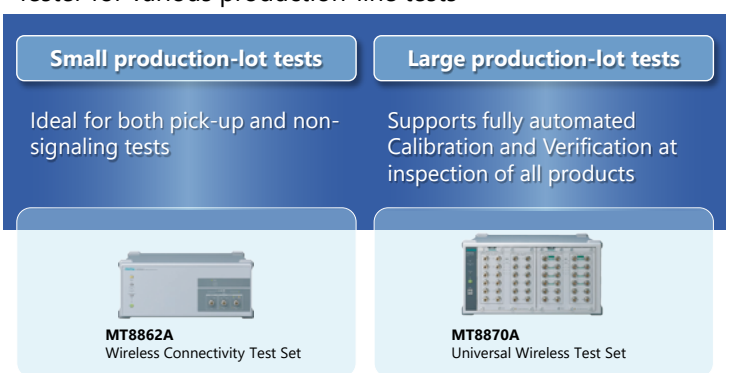
4.3 Large-Scale Manufacturing/Production Line Testing

Universal Wireless Test Set MT8870A

The Universal Wireless Test Set MT8870A is designed for production lines manufacturing wireless communications devices, including WLAN products. In addition to supporting WLAN, it also supports various other wireless communication standards, such as Bluetooth®, 5G NR Sub-6 GHz, and LTE. Featuring non-signaling mode measurements, it is ideal for large-scale mass production lines because it supports high-speed measurements including calibration/correction to evaluate the RF characteristics of customers' products.

Product Details: MT8870A product page

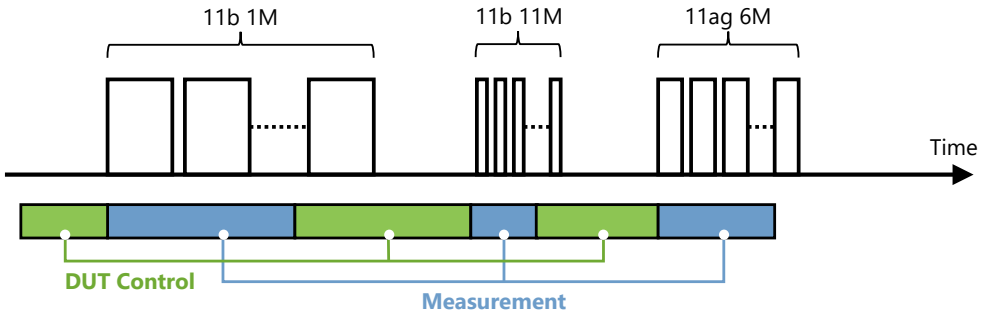
Tester for various production-line tests



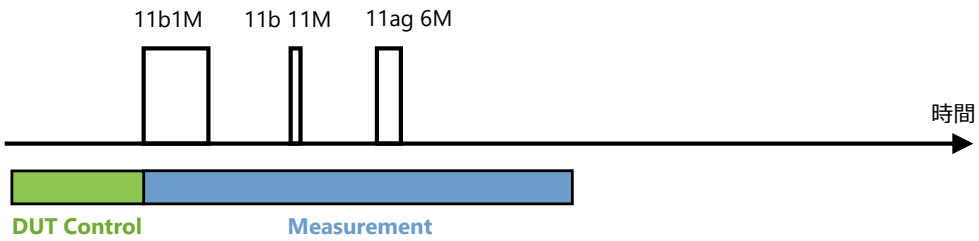
Non-Signaling Mode Test Methods

The non-signaling mode is divided broadly into two test methods: the non-list mode, and list mode. These modes have different DUT control methods and measurement procedures. The non-list mode tests by alternately controlling and measuring the DUT, while the list mode shortens the test time by performing multiple measurements in one control cycle by using predetermined list information for multiple measurement conditions saved in the chipset. The MT8862A supports the non-list mode while the MT8870A supports both list and non-list modes.

Non-List Mode (Conventional)



List Mode (Sequence Method)



5. Conclusion

This evaluation guide should help you understand the required tests when developing your company's WLAN products.

Understanding fully what measurements are required at each phase of development and production requires knowledge and measurement-related experience.

Anritsu is an industry leader in test and measurement of wireless products, offering expert measurement solutions and expertise to engineers developing and manufacturing WLAN products. If you would like more information on Anritsu test and measurement solutions, please feel free to reach out to your Anritsu sales representative or visit anritsu.com

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