

WLAN Product Evaluation Examples

Benchmark Test

-Introduction to WLAN Measuring Instruments-

Wireless Connectivity Test Set MT8862A

Recently, WLAN functions are appearing in digital cameras, robotic vacuum cleaners, household white goods, cameras, sensors, machinery, etc., and the range is expected to expand as more IoT products appear.

Generally, WLAN communications are implemented in these equipment and products using a "WLAN module."

On the other hand, customers are increasingly wanting to

"Compare our products"

"Compare with other makers' products"

in terms of WLAN performance and functions. This is the Benchmark Test.



As these backgrounds, if the **transmitter and receiver performance of finished products with built-in WLAN modules is not confirmed**, there is increasing risk of the following **complaints from customers** using these products, which makes advance comparative evaluation very important.

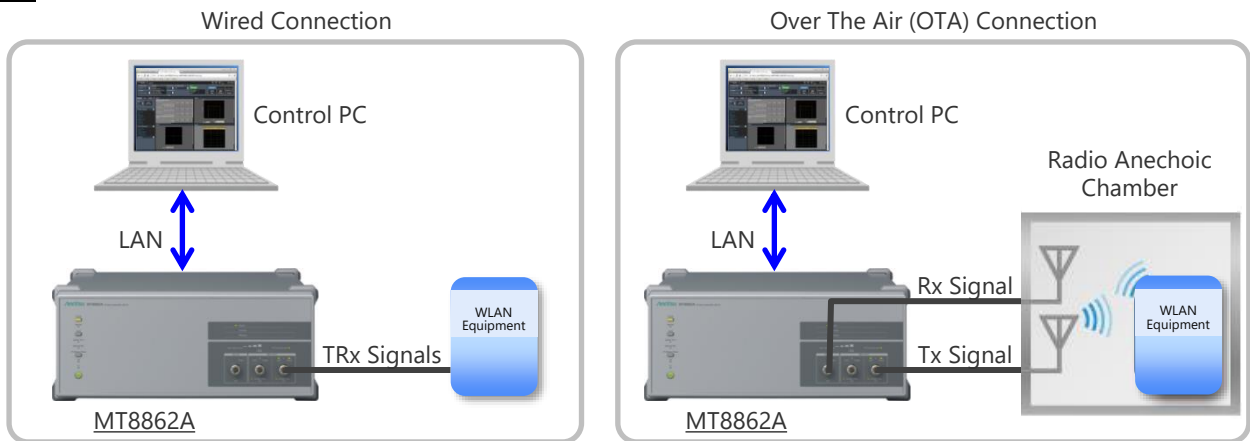
- ✓ After I traded-in for a better model, my connection speed is slower than before.
- ✓ Company B's products are slower than Company A's.
- ✓ I can connect with Company C's product but Company D's are difficult to connect and get dropped easily.

"WLAN performance is different between WLAN modules and finished products, making finished-product evaluation very important."

Confirming Finished Product Transmitter and Receiver Performance

■ Under Close-to-Live Operation Conditions (Network Mode)

The MT8862A supports Network Mode for evaluating the wireless quality of finished WLAN products under close-to-live operation conditions. It evaluates transmitter and receiver performance using simple connections realizing general WLAN communications procedures.



The DUT communications conditions are controlled by the MT8862A to perform quantitative evaluations with good reproducibility.

- ✓ Communications standards (11a/b/g/n/ac/ax/be)
- ✓ Transmission Rate (54 Mbps, etc.)
- ✓ Channels (Frequency)*¹

Evaluation Items Using MT8862A

Tx Performance: Power, Modulation Accuracy (EVM*²), etc.

Rx Performance: Rx Sensitivity (PER*³)

*¹: Controlled by MT8862A in Access Point mode

*²: EVM = Error Vector Magnitude

*³: PER = Packet Error Rate

These materials introduce comparative evaluation of transmitter and receiver characteristics for a "product" with built-in WLAN communications functions. First, they introduce examples 1, 2, and 3 for benchmarking the modulation accuracy (EVM) transmitter characteristic.

What is modulation accuracy (EVM)?

The figures on the right show examples of 64QAM constellation screens.

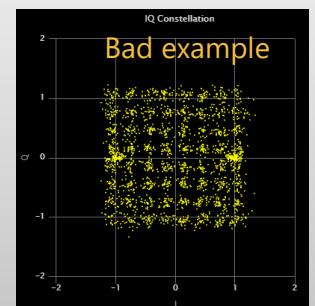
For 64QAM, the number of symbol points is 8 x 8 on the vertical and horizontal axes. Error Vector Magnitude (EVM) is an index expressing the difference between theoretical and actual symbol points as a percentage.

Symbol points with good modulation accuracy are each focused at one point whereas they are diffused when the modulation accuracy is poor. A product with poor modulation accuracy does not receive signals correctly and the communications speed may decrease with more dropped connections.

Symbol point Examples of Constellation Screens (From Example 1)



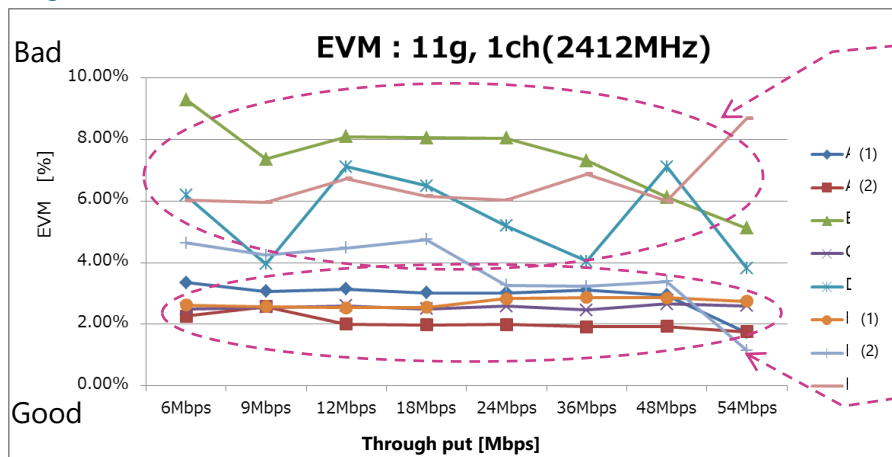
Modulation accuracy EVM rms
Company E (2) 1.8%



Modulation accuracy EVM rms
Company F 9.5%

Transmitter Characteristics Benchmark Example 1: Performance Differences due to Transmission Rate = Changes in Modulation Method

It is important to confirm each modulation accuracy when changing the transmission rate and modulation method. In example 2, some products are stable at all transmission rates but others suffer changing modulation accuracy when the transmission rate changes.

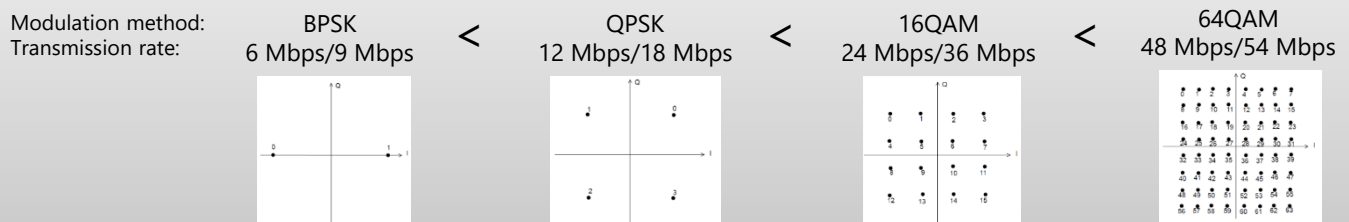


Companies B, D, E (2) and F:
Modulation accuracy changes with transmission rate and some are degraded by almost 10%.

Company E (2):
Modulation accuracy is excellent at 54 Mbps but degrades as transmission rates drop and is about 5% worse at 6 Mbps.

Companies A (1), A (2), C and E (1):
Modulation accuracy is stable (2% to 3% change) and does not drop with transmission rate, supporting excellent transmitter characteristics.

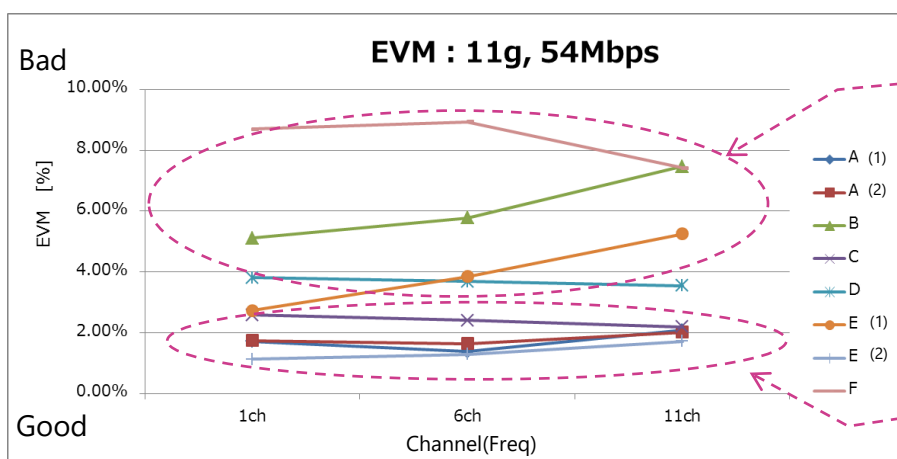
Relationship between modulation method and transmission rate: What is BPSK/QPSK/16QAM/64QAM?



This example shows a combination of modulation method (top) and transmission rate (bottom) for 11a/g. The transmission rate becomes faster as the number of modulation symbols increases. However, since the inter-symbol gap becomes smaller with more symbols, transmissions are more easily affected by noise, etc.

Transmitter Characteristics Benchmark Example 2: Performance Differences Due to Channel = Frequency

Changing the equipment channel and frequency affects modulation accuracy due to the frequency characteristics performance. In example 3, the modulation accuracy of some products is stable even when the channel is changed but other products suffer changes in modulation accuracy with channel changes.



Companies B, D, E (1), and F:
Modulation accuracy changes with channel/frequency. There are two groups: one group with degraded modulation accuracy at higher frequencies, and a second group with degraded modulation accuracy at lower frequencies.

Companies A (1), A (2), C, and E (2):
Modulation accuracy is stable (2% to 3% change) and does not drop with channel/frequency, supporting excellent transmitter characteristics.

Transmitter Performance Summary

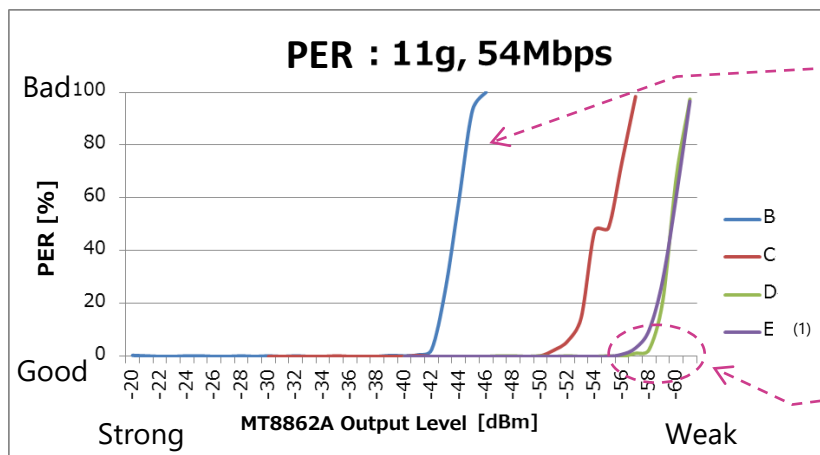
Some products experience changes in modulation accuracy with transmission rate/modulation method and channel/frequency. The examples in this document help clarify the excellent transmitter characteristics of products from Companies A (1) and A (2), and C.

The next section introduces a comparison example for the packet error rate (PER^{*4}) as receiver characteristic.

^{*4}: PER = Packet Error Rate

Receiver Characteristics Benchmark Example

It is important to confirm the receiver characteristics of finished products with built in WLAN modules. This example confirms differences in receiver sensitivity levels between products.



Company B:

This product suffers errors at a higher level than other companies' products and has poor receiver performance. In other words, it has a narrow range in which it can receive, which probably causes longer communications times.

Companies D and E (1):

These companies' products can receive at lower levels than other companies. In particular, Company D has the most excellent receiver performance since its product can receive at lower levels than levels where Company E starts to occur errors.

Receiver Performance Summary

Not only receiver sensitivity level but also increases in error rates (trends) change with product.

The example in this document clearly demonstrates the excellent receiver characteristics of products from Companies D and E (1).

Confirming Transmitter and Receiver Performance of Finished Products with Security Functions

Measurements of finished products with Security <MX886200-020 WLAN Security Function>

The MT8862A can connect and perform measurements without disabling the WLAN product security settings.

- WLAN IEEE802.11a/b/g/n/ac/ax/be (2.4/5/6-GHz bands) [Access Points/Stations]
- WEP, WPA-Personal, WPA2-Personal, WPA3-Personal
→The MT8862A simulates Access Points (AP) and Stations (STA).

The security function is required in the following evaluation scenarios.

- ✓ At final shipping evaluation with security function enabled
- ✓ When product can be set to security either as AP or STA and requires evaluation for both security functions

Conclusion

Benchmark tests are important not only for comparison with other manufacturers products but also for in-house evaluations of old and new models, comparison at different design stages, comparison between different production lots, etc., to quantitatively evaluate the transmitter and receiver performance of finished products with high reproducibility. These types of evaluations reduce the risks of WLAN performance problems, such as poor and dropped connections, as well as low connection speeds, helping reduce negative effects on sales, service, and brand image.