Anritsu Advancing beyond

Evaluating WLAN Products
Receiver Characteristics
-Introduction to WLAN Measuring Instruments-

Wireless Connectivity Test Set MT8862A

Wireless communications functions are now being built into various recent products, such as digital cameras, cleaning robots, household electrical goods, cameras, sensors, industrial equipment, and the future growth of IoT is expected to further increase wireless deployments.

Generally, a **wireless LAN (WLAN) module** is used to implement WLAN functions in these products and equipment.

Even if the WLAN module meets IEEE and radio legislation requirements, **there is a risk of problems if the WLAN has not been evaluated after implementation as the finished product.**

Wireless Connectivity Test Set
MT8862A

WLAN Module

~ Finished WLAN Product Problems ~

- ✓ **Increased user claims about connection failures**
- ✓ **Damaged reputation due to online reports claiming slower speeds than competitors**

[Assumed Risks]

- ✓ **Weak Rx sensitivity reduces WLAN service area**
- ✓ **Constant communications errors**
  → **Slower communications speeds**

Reducing these problems and risks requires evaluation of Rx characteristics of finished products with implemented WLAN modules.

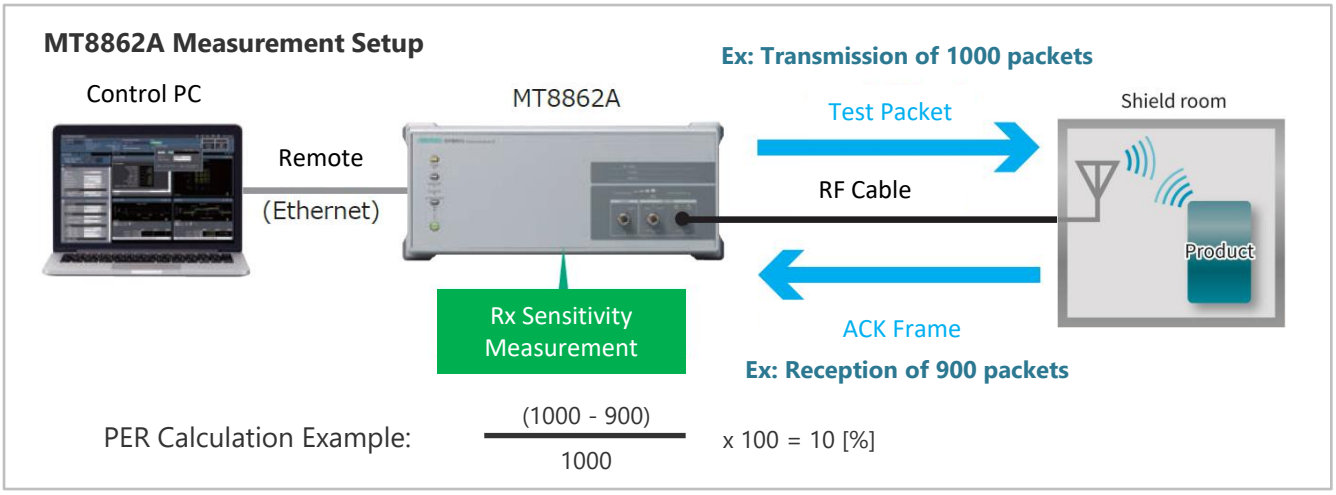
Receiver Minimum Input Level Sensitivity Evaluation

Minimum Input Level Sensitivity Tolerance

IEEE802.11 defines the required WLAN product specifications, such as the Tx and Rx characteristics, and minimum input level sensitivity is one of the Rx evaluation items. The IEEE standard defines Receiver Minimum Input Level Sensitivity. At this test, the signal from the transmitter is input to the DUT WLAN product and the level is gradually reduced while measuring the Rx level where the Packet Error Rate (PER) becomes 10%.

What is Packet Error Rate?

A fixed number of packets is sent from MT8862A to the DUT (Product) and the number of (error) packets not received by the DUT is expressed as a percentage.



Example: IEEE 802.11 17.3.10.2
Table 17-18 Receiver performance requirements

WLAN products must have a minimum sensitivity level lower than the value specified by IEEE802.11.

Products that can receive weak signals at lower levels are evaluated as having good Rx sensitivity.

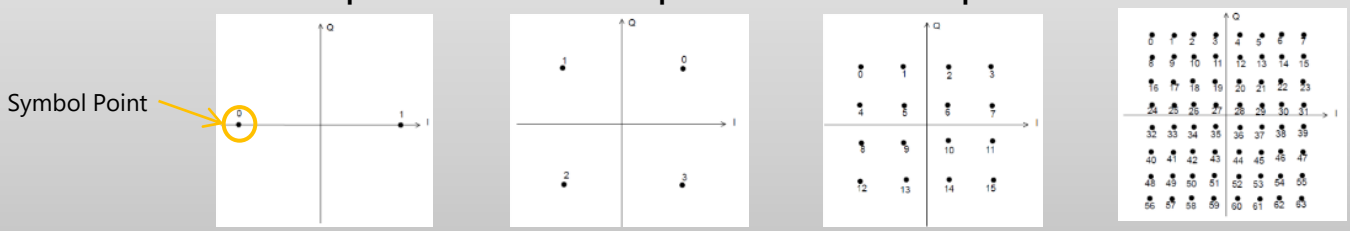
Modulation	Code Rate	Minimum Sensitivity [dBm]			Transmission Speed
		20 MHz ch	10 MHz ch	5 MHz ch	
BPSK	1/2	-82	-85	-88	6 Mbps
BPSK	3/4	-81	-84	-87	9 Mbps
QPSK	1/2	-79	-82	-85	12 Mbps
QPSK	3/4	-77	-80	-83	18 Mbps
16QAM	1/2	-74	-77	-80	24 Mbps
16QAM	3/4	-70	-73	-76	36 Mbps
64QAM	2/3	-66	-69	-72	48 Mbps
64QAM	3/4	-65	-68	-71	54 Mbps

Source: IEEE Std 802.11-2020

Relationship Between Modulation Method and Transmission Rate: What are BPSK/QPSK/16QAM/64QAM?

For example, the 11a/g modulation method (top) and transmission rate (bottom) combinations are listed below.

Modulation method: BPSK < QPSK < 16QAM < 64QAM
Transmission Rate: ~9 Mbps < ~18 Mbps < ~36 Mbps < ~54 Mbps



The amount of transmitted data increases as the number of modulation symbols increases. However, since the gap between adjacent symbols becomes narrower as the number of symbols increases, the transmission is more easily affected by noise.

Since the transmission rate (speed) changes with WLAN communication conditions, quantitative evaluation is possible only by measuring by specifying the DUT transmission rate.

Introduction to MT8862A Rx Characteristics Evaluation Function

Outline

- The MT8862A sends a unique UDP packet (Test Packet) to the WLAN product and counts the ACK frames sent back from the product to measure the PER (Packet Error Rate) /FRR (Frame Reception Rate).
- Using the network mode, the Rx performance of the finished WLAN product can be evaluated in a near-to-actual usage environment.

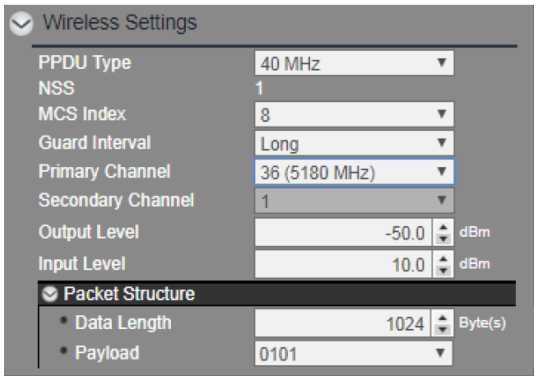
Rx Measurement Items

No.	Measurement Items
Numeric Result	
1	Packet Error Rate List (PER List)
2	Frame Reception Rate List (FRR List)
Graph Result	
1	Packet Error Rate (PER)
2	Frame Reception Rate (FRR)

The MT8862A evaluates Rx sensitivity under fixed channel (frequency), transmission rate, output level, etc., conditions.

Wireless Settings

The screens on the right are for 11ac wireless settings. They are for evaluating at various settings, such as PPDU type (bandwidth), MCS Index (transmission rate), primary channel (frequency), etc. The same settings, such as channel (frequency), transmission rate (modulation method), etc., can be set for 11a/b/g/n.



Wireless Setting Screen (11ac)

Test Parameter

This sets the number of measurement packets. Adjust the delay time as necessary.

Packet Structure

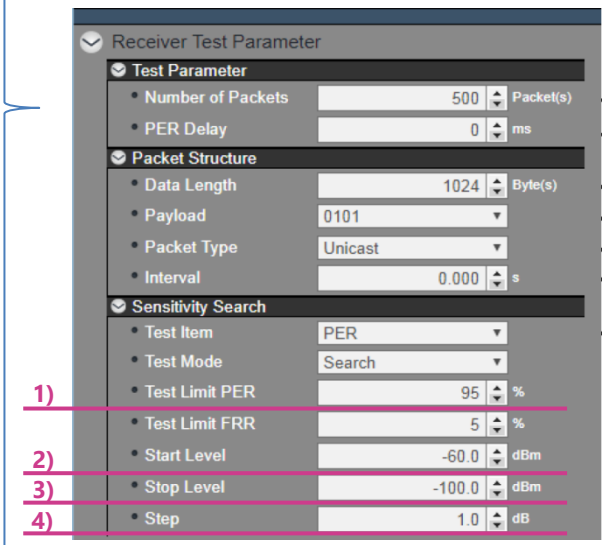
This sets the packet data length, payload type used at data communications, packet data type, and interval length between packets.

It is important to check limitations, such as interval or data length needed to receive, etc., at the module adoption stage.

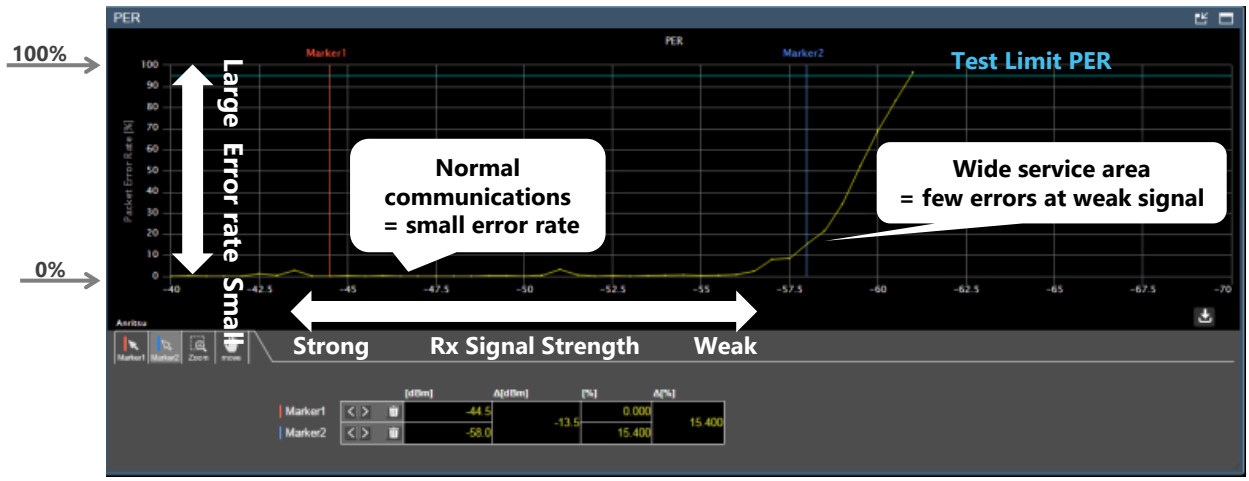
Sensitivity Search

Generally, Rx level is measured as PER while changing the measuring instrument output level either manually or automatically. At manual measurement, the level is set and the PER measurement result is captured before changing the level and repeating PER measurement over again several times, so manual evaluation requires a lot of time. On the other hand, configuration of an automatic measurement system requires a lot of work to program control of measuring instruments.

The MT8862A can capture PER measurement results using four parameter input settings: 1. Test Limit PER, 2 and 3. MT8862A signal output Start Level and Stop Level, and 4. step size as shown in the screen on the right. As shown in the following graph, the MT8862A has an automatic graphing function as standard. In addition, it also saves captured results to a file for later post-measurement analysis.



Wireless Setting Screen (11b)



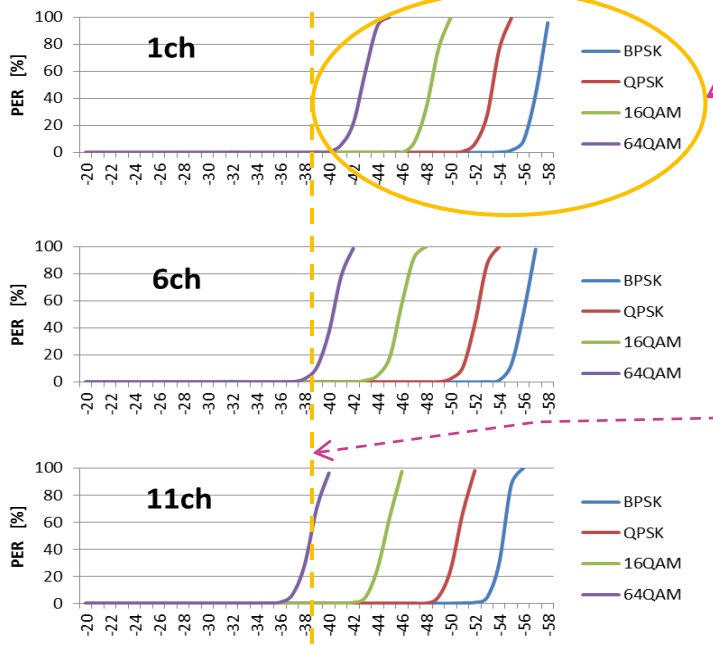
MT8862A PER Measurement Graph

PER measurement results are captured up to the specified sensitivity (Test Limit PER) while changing the level automatically.

Example of Minimum Input Sensitivity Level Measurements using MT8862A (Comparison of Two Commercial Products)

Product A

11g, 2.4 GHz band
Rx sensitivity of each channel (frequency) and transmission rate (modulation method)



Transmission Rate (Modulation Method):
Rx sensitivity becomes better and transmission rate becomes slower when changing from 64QAM to 16QAM to QPSK to BPSK.

If the measurement target is a connected access point (AP) or smartphone, quantitative evaluation is impossible because the transmission rate cannot be fixed.

Frequency Characteristics:

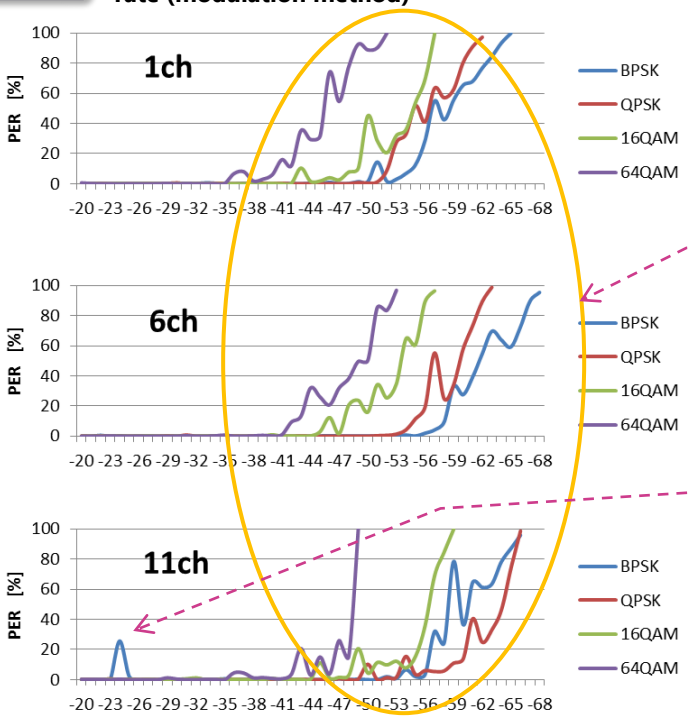
We found that the sensitivity is good at low frequencies and poor at high frequencies by switching between 1ch, 6ch and 11ch (frequency).

When first choosing the WLAN module, it is important to confirm that performance meets the final operating specifications.

It is also important to confirm that the module specifications have been maintained in the finished product.

Product B

11g, 2.4 GHz band
Rx sensitivity of each channel (frequency) and transmission rate (modulation method)



Unique WLAN Product/Module Characteristics:
The figures on the left show PER measurements for a different WLAN product (Product B).

Generally, as shown in the top figure (Product A), PER increases smoothly by a few dB near the sensitivity point. However, with this WLAN product (Product B), the error rate also exceeds 10% at higher levels.

Fault Error:
Errors of more than 20% are generated at a level where errors do not naturally occur.

Ordering Information

We recommend the following MT8862A composition for evaluating WLAN TRx connection characteristics.

Model	Name	Remarks
MT8862A	Wireless Connectivity Test Set	Main Unit
MT8862A-001	RF Frequency 2.4 GHz, 5 GHz*1	Required option
MX886200A	WLAN Measurement Software*2	For IEEE 802.11b/g/a/n TRx evaluations
MX886200A-001	WLAN 802.11ac Option*3	For IEEE 802.11ac TRx evaluations
MX886200A-020	WLAN Security Function*3	Supports WEP, WPA-Personal, WPA2-Personal

*1: Requires MT8862A *2: Requires MT8862A-001 *3: Requires MX886200A

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