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.

[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.
IEEE 802.11 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 Std 802.11™-2012 18.3.10.2**
Table 18-14 Receiver performance requirements

<table>
<thead>
<tr>
<th>Modulation</th>
<th>Code Rate</th>
<th>20 MHz ch</th>
<th>10 MHz ch</th>
<th>5 MHz ch</th>
</tr>
</thead>
<tbody>
<tr>
<td>BPSK</td>
<td>1/2</td>
<td>-82</td>
<td>-85</td>
<td>-88</td>
</tr>
<tr>
<td>BPSK</td>
<td>3/4</td>
<td>-81</td>
<td>-84</td>
<td>-87</td>
</tr>
<tr>
<td>QPSK</td>
<td>1/2</td>
<td>-79</td>
<td>-82</td>
<td>-85</td>
</tr>
<tr>
<td>QPSK</td>
<td>3/4</td>
<td>-77</td>
<td>-80</td>
<td>-83</td>
</tr>
<tr>
<td>16QAM</td>
<td>1/2</td>
<td>-74</td>
<td>-77</td>
<td>-80</td>
</tr>
<tr>
<td>16QAM</td>
<td>3/4</td>
<td>-70</td>
<td>-73</td>
<td>-76</td>
</tr>
<tr>
<td>64QAM</td>
<td>2/3</td>
<td>-66</td>
<td>-69</td>
<td>-72</td>
</tr>
<tr>
<td>64QAM</td>
<td>3/4</td>
<td>-65</td>
<td>-68</td>
<td>-71</td>
</tr>
</tbody>
</table>

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.

### 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.

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.
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.

- **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 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.

### 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.

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

#### 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.

#### 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.

<table>
<thead>
<tr>
<th>Model</th>
<th>Name</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT8862A</td>
<td>Wireless Connectivity Test Set</td>
<td>Main Unit</td>
</tr>
<tr>
<td>MT8862A-001</td>
<td>RF Frequency 2.4 GHz, 5 GHz</td>
<td>Required option</td>
</tr>
<tr>
<td>MX886200A</td>
<td>WLAN Measurement Software</td>
<td>For IEEE 802.11b/g/a/n TRx evaluations</td>
</tr>
<tr>
<td>MX886200A-001</td>
<td>WLAN 802.11ac Option</td>
<td>For IEEE 802.11ac TRx evaluations</td>
</tr>
<tr>
<td>MX886200A-020</td>
<td>WLAN Security Function</td>
<td>Supports WEP, WPA-Personal, WPA2-Personal</td>
</tr>
</tbody>
</table>

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