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## WLAN Devices Issues with Poor Sensitivity USB Noise

-Noise problems that cannot be solved simply by clearing EMC regulations-

Wireless Connectivity Test Set MT8862A

Wireless LAN (WLAN) Internet connectivity is no longer restricted to smartphones and PCs, but is now also commonplace in home electrical equipment, such as TVs, Blu-ray recorders, etc. However, new electrical devices with built-in WLAN often suffer from connection problems due to various factors. This leaflet describes some typical issues caused by noise from USB ( the Universal Serial Bus ) and explains effective methods for identifying these issues.

USB first appeared as a wired communications standard with a maximum speed of 12 Mbps, targeting slower applications, such as the PC mouse and keyboard. Due to its convenience and wide applicability, supported speeds increased with new standards updates.

### USB Standards and Maximum Transmission Speed

Standard	USB 1.0	USB 1.1	USB 2.0	USB 3.2 Gen 1	USB 3.2 Gen 2	USB 3.2 Gen 2x2	USB 4
Max. Speed	12 Mbps	12 Mbps	480 Mbps	5 Gbps	10 Gbps	20 Gbps	40 Gbps

Although faster USB speeds bring large benefits to users, conversely, they have possibility of cause **interference issues for the 2.4 GHz band** used commonly by wireless communications and particularly by WLAN.

The USB 3.2 Gen 1 standard implements high-speed communications at 5 Gbps. And the digital transmission reference frequency is 2.5 GHz, which can radiate as interference noise in the 2.4 GHz band without appropriate design, evaluation and leakage countermeasures.



Source: "USB 3.0 Radio Frequency Interference Impact on 2.4 GHz Wireless Devices", Intel Corporation

\*"USB3.0" is a variation on the name for the new "USB 3.2 Gen 1" standard.

Not only does noise radiated from USB 3.2 Gen 1 devices degrade the **signal-to-noise ratio** (SNR), it also reduces communications speeds and causes dropped connections due to poor sensitivity.



Solving these serious noise issues generally requires characterization of the noise source by using a measurement probe and spectrum analyzer, addition of filters and shielding, changes to parts layout, etc., to cut the noise to a level having no effect on WLAN communications. So, it is best way to improve communications quality by evaluation using a spectrum analyzer and Wireless Connectivity Test Set. This page describes the evaluation results for the USB interfaces of two laptop PCs (A and B) measured as described on the previous page using a spectrum analyzer, showing the characteristic trends of each. The laptop PCs were chosen at random but these two PCs clearly have issues with unstable WLAN communications due to use of USB memory.

- Measurement Setup
   Laptop PC A
   Spectrum Analyzer MS2830A
- Measurement Results



Remarks Based on Measurement Results

- USB noise believe to cause drop in WLAN communications quality
- Unknown degree of degraded Rx performance (Error Rate)
- Cannot clarify how much to decrease noise

 Mission
 Spectrum Analyzer
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 -68.01 dBm
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 2.490 740 000 00 GHz
 -68.01 dBm
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 10001 points

 2
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 Positive
 10001 points

 2
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 Positive
 10001 points

 2
 Cannot confirm noise generated by USB
 10001 points

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**Evaluation Method** 

interface.

laptops. (Measurement Result:

memory. (Measurement Result: -

Noise radiated in the 2.4 GHz band was measured with just the USB memory stick inserted in the

Noise radiated in the 2.4 GHz band was measured while copying a file between the PC and USB

Any difference between the blue and red lines was regarded as noise generated from the USB

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- USB noise believed not to cause drop in WLAN communications quality
- Laptop PC B seems not be the cause but the cause may be access point (AP) problem
- Laptop PC B seems not be the cause, but the cause may be poor radio-wave environment

With these spectrum analyzer evaluation results, although the WLAN communications phenomena may be similar, USB noise was observed only for laptop PC A. **However, in fact laptop PC B also suffers from unstable WLAN communications.** 

Using this evaluation method, noise radiated as radio waves outside the laptop PC case can be detected, but noise can propagate to the WLAN module via different paths, **for which evaluation using a spectrum analyzer is only partly effective.** Moreover, since changes in the Error Rate cannot be clarified, it is impossible to set noise-reduction target value.

And risks, such as increasing **customer dissatisfaction**, can harm business if misdiagnosis leads to continuing problems with laptop PC B.

Anritsu's Wireless Connectivity Test Set MT8862A provides an evaluation method for noise issue as a different method to conventional spectrum analysis. With its easy method for measuring the WLAN module Rx performance (Error Rate), it can capture the degree of Error Rate change caused by USB noise. And it is clear how much to set the target noise level.

This page explains evaluation of the two laptops PC A and B using the MT8862A instead of a spectrum analyzer.

Measurement Setup



- Evaluation Method
  - The error rate was measured by sending packets from the MT8862A while decreasing the Tx power and counting the packets received by the laptop PC WLAN with the USB memory stick inserted in the laptops. (Measurement Result: \_\_\_\_\_)
  - The error rate was measured by sending packets from the MT8862A while decreasing the Tx power and counting the packets received by the laptop PC WLAN while copying a file between the PC and USB memory. (Measurement Result: — )

Measurement Example

MT8862A

MT8862A Tx WLAN Signal	Power Level	SNR	Tx Packet Count	Rx Packet Count	Error Rate	Comms Quality	Relative Speed Based on Speed at 0% Error Rate
Gradual Tx Power Decrease	Max	Max G	1000	1000	0%	Excellent	100%
	High	High	1000	900	<b>10%</b>	Good	< <b>90</b> %
	Med	Med	1000	500	<b>50%</b>	Poor	<50%
$\sim$	Low	Low	1000	0	100%	No Good	0%

#### Measurement Result



### Remarks Based on Measurement Results

- Confirms sensitivity drop due to USB noise
- 6 dB difference at 100% error rate power level
   Requires about 6 dB drop in USB noise for no drop in quality due to USB noise. Communications range becomes shorter with no noise countermeasures.

•	Confirms	sensitivity	drop	due	to	USB n	oise
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- Low Rx performance in comparison to laptop PC A, with or without USB noise
- With USB noise, quality does not deteriorate gradually with communications distance but fails suddenly
- 6 dB difference at 100% error rate power level
   →Requires about 6 dB drop in USB noise for no drop in quality due to USB noise. Communications range becomes shorter with no noise countermeasures.

The measurement results of MT8862A show that not only PC A, PC B also has the noise issue which was not discovered by estimation only using a spectrum analyzer. Additionally, it showed the Rx performance of laptop PC B was lower than that of laptop PC A. Since the Wireless Connectivity Test Set MT8862A measures built-in WLAN performance under actual operating conditions, it is ideal for measuring Rx performance of WLAN module accurately in various noise environments includes USB.

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