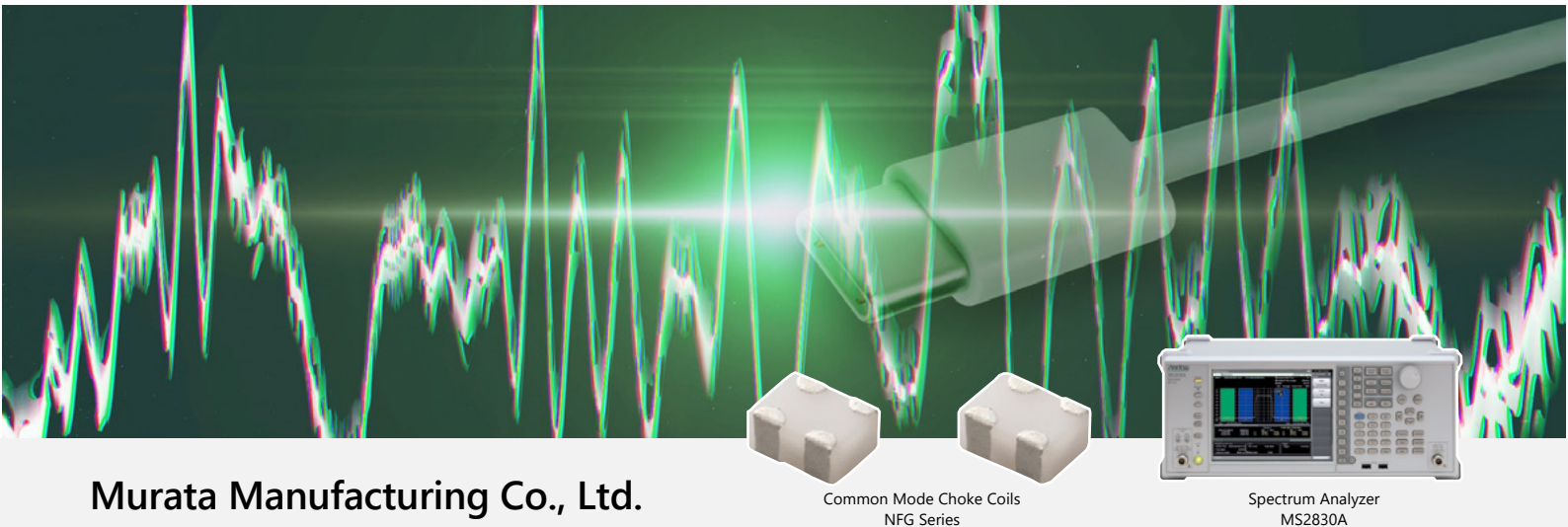




Murata Manufacturing Co., Ltd.

Common Mode Choke Coils
NFG Series

Spectrum Analyzer
MS2830A

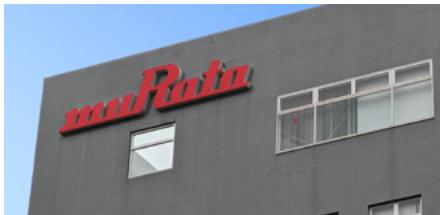
Construct an RFI Test Environment Established by USB-IF with a Spectrum Analyzer Propose Solutions to EMC Problems Through Effective Utilization of Common-Mode Choke Coils

Utilization Purpose

Leverage Murata's common-mode choke coil products and the noise suppression knowledge accumulated by Murata.
Promote effective solutions for reducing USB noise.



Name: Murata Manufacturing Co., Ltd.
Established: 23 December, 1950
Common Stock: 69,444 million yen (as of March 31, 2023)
Number of Employees: 73,164 (as of March 31, 2023)
Functions: Research, Production, and Sales of Electronic Devices made from fine ceramics
Products: Multilayer Ceramic Capacitors, SAW Filters, Ceramic Resonators, Crystal Units, Piezoelectric Sensors, Piezoelectric Buzzers, Short-range Wireless Communication Modules (including Bluetooth Modules), Multilayer Ceramic Devices, Connectors, Isolators, Power Supplies, Circuit Modules, EMI Suppression Filters, Inductor (coils), Sensors, Lithium-Ion Batteries
Head Office: 1-10-1 Higashikotari, Nagaokakyo-shi, Kyoto, Japan
URL: <https://www.murata.com/>



Products Utilized

Spectrum Analyzer/Signal Analyzer MS2830A
Built-in functions including the vector/analog signal generator contribute to more efficient development and manufacturing.
9 kHz to 13.5 GHz

Background

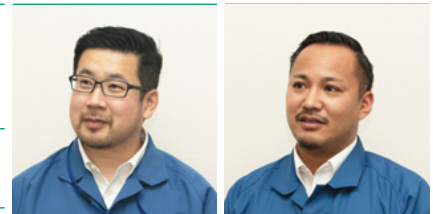
To address the deterioration in wireless communication quality caused by electromagnetic noise during USB 3.2 communication, the USB-IF established the RFI Test.

Utilization

Construct a noise-evaluation environment that is fully compliant with the standards using the spectrum analyzer MS2830A.

Introduction Results and Prospects

Clarify the mechanism leading to noise generation during USB 3.2 communication and establish noise suppression solutions. Take on the challenge of developing new countermeasures for noise in cutting-edge communication technologies.



Technology Development
Section1
Application Development
Dept.
EMI Filter Division
Mr. Masaki Nakase, Manager

Technology Development
Section1
Application Development
Dept.
EMI Filter Division
Mr. Keisuke Oota

Background

To address the deterioration in wireless communication quality caused by electromagnetic noise during USB 3.2 communication, the USB-IF established the RFI Test.

Under the corporate slogan "Innovator in Electronics," Murata Manufacturing Co., Ltd. (hereinafter referred to as "Murata") provides electronic devices and equipment to various global markets, including communications and automotive industries. Through a vertically integrated production system that covers the entire process from materials to finished products, Murata produces highly unique products that have achieved significant market shares across different fields. Moreover, these products have consistently generated exceptionally high profit margins within the electronics components industry.

Murata's EMI Division specializes in developing noise suppression solutions for a wide range of markets, including commodity markets, automotive industry, industrial electrical equipment, and others. By utilizing Murata's proprietary technologies and introducing state-of-the-art inductive devices to the market, Murata has been able to effectively meet customer demands.

The EMI Division of Murata addresses customer concerns by utilizing evaluation boards and other tools to propose the best components for specific applications. They also provide support for noise evaluation, making use of resources like Murata's anechoic chambers.

The division is currently focusing on addressing electromagnetic noise issues associated with the USB Type-C standard, which is rapidly becoming the industry standard. In the past, electronic devices such as laptops have featured various connectors and cables, leading to a proliferation of standards for external interfaces. However, there has been a recent trend towards unifying these connectors under the USB Type-C standard to support different interfaces. One challenge with USB 3.2 communication is that it tends to generate significant amounts of noise in the 2.4 GHz band. This has resulted in major issues such as reduced transmission speeds and degraded communication quality, as the noise from USB communications interferes with wireless LAN and Bluetooth® wireless communication devices.

In response to this issue, the USB Implementers Forum (USB-IF), the organization responsible for standardizing USB technology, introduced a new "USB 3.2 RFI System-Level Test (RFI Test)" noise standard in 2021 for USB communications. This standard outlines a testing method to ensure that USB devices do not impact the quality of wireless LAN communications. It aims to address the problem of noise interference during USB 3.2 communication, which can disrupt the functioning of peripheral wireless devices such as mice and headsets.

Utilization

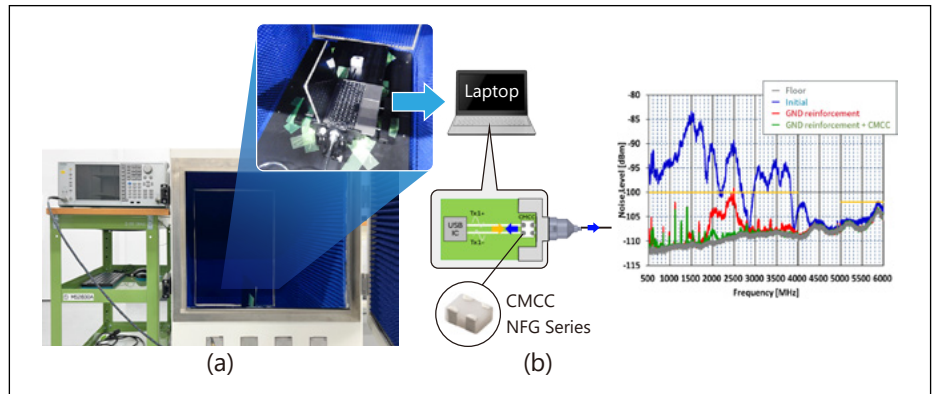
Construct a noise-evaluation environment that is fully compliant with the standards using the spectrum analyzer MS2830A.

Noise suppression solutions are one of Murata's core strengths. Murata has a track record of providing and suggesting customized noise suppression solutions based on the specific circuit characteristics of its customers. Mr. Nakase from the Application Development Department of the EMI Filter Division highlighted the key features of our flagship product, the common mode choke coil (CMCC), as follows.

The CMCC NFG series exhibits excellent noise suppression and transmission characteristics across various frequency bands, including wireless LAN, Bluetooth technology, 5G NR Sub6, and more. These noise suppression products are highly effective for all high-speed transmission interfaces such as USB and HDMI. CMCCs efficiently suppress noise while maintaining signal integrity. Leveraging the capabilities of these CMCCs, we have successfully developed solutions to address diverse noise-related issues.

In response to the noise issues related to USB Type-C, Murata took immediate action and started developing noise suppression solutions. Murata demonstrated its proactive approach by being one of the first companies to establish the RFI Test environment for USB-IF's new noise standard and develop corresponding noise suppression techniques. Mr. Oota from the EMI Filter Division shares his thoughts on these significant achievements as follows.

The objective of this project was to offer customers who face challenges with noise characteristics in USB device research and development practical examples of noise suppression measures and solutions.



(a) Spectrum analyzer MS2830A and RFI test environment established in Murata

(b) Noise suppression solutions

Insert the Fixture specified by the USB-IF into the Type-C receptacle of the DUT and connect it to the spectrum analyzer through a coaxial cable.

The DUT transmits a test signal. A judgment is made whether the noise observed with the spectrum analyzer meets the limit.

In order to accomplish this, we promptly conducted a thorough examination of the RFI Test requirements and established an evaluation environment.

I believe our greatest advantage lies in our comprehensive understanding of the measurement principles of the RFI Test, our ability to elucidate the mechanisms behind noise generation, and our capability to establish optimal noise-control measures.

Mr. Nakase also pointed out the most challenging aspect: "Simply installing our noise suppression CMCC products will not solve the noise problem. Therefore, we utilized our knowledge and experience in noise control and conducted multiple

hypothesis verifications. Through trial and error, we combined measures such as enhancing the GND of the Type-C connector and suppressing common-mode signals based on the installation location of CMCCs to effectively eliminate noise."

To establish an evaluation environment for the RFI Test, Murata employed Anritsu's spectrum analyzer "MS2830A," which is specified in the RFI Test procedure document. They evaluated the noise generated by a USB 3.2 circuit and validated the effectiveness of their CMCCs by applying them while drawing upon their expertise in noise control.

Introduction Results and Prospects

Clarify the mechanism leading to noise generation during USB 3.2 communication and establish noise suppression solutions. Take on the challenge of developing new countermeasures for noise in cutting-edge communication technologies.

Mr. Oota highly praises the "MS2830A" used by Murata for evaluating noise suppression solutions, stating, "I find the Anritsu MS2830A to be excellent due to its user-friendly interface and reduced risk of operational errors. The ability to simultaneously output multiple sets of trace data in CSV format greatly enhances evaluation efficiency. Additionally, the MS2830A is equipped with a signal generator, which we utilize for other noise evaluations such as RF dummy signal outputs in noise-immunity tests."

The USB 3.2 noise suppression solutions have successfully clarified the "noise generation mechanism and measures." By combining impedance matching through reinforced GND of the Type-C connector with CMCC installation on signal wiring, common mode noise has been effectively suppressed. These measures have been demonstrated in RFI Tests using laptops as the Device Under Test (DUT). As a result of these achievements, Murata

has received high praise from numerous customers.

Furthermore, collaborative research with other device manufacturers is ongoing, and their noise suppression measures are expected to become industry standards. The future markets that the EMI Division will serve, including connectivity and automotive sectors, are witnessing advancements such as Wi-Fi 7 and USB 4.0 proliferation, accelerated data transmission like PCIe 6.0 adoption, and progress in AD/ADAS systems in automobiles. In these markets, addressing noise issues has become even more critical.

"In the markets where the EMI Division operates, further device miniaturization and interface acceleration along with high-density circuit integration will continue to advance. Consequently, challenges such as self-interference within electronic devices and deterioration of RF communication quality are likely to become more prominent," explains Mr. Nakase. Moreover, with increasing adoption of

cutting-edge technologies like AR/VR and IoT devices, more complex noise problems are expected to arise. Murata aims to leverage its expertise to provide innovative solutions.

Looking towards the future when new communication standards like 6G emerge Mr. Oota expresses his hope that Anritsu will promptly develop test instruments capable of evaluating according to those standards: "We rely on Anritsu's system that can evaluate state-of-the-art communication technologies with high reproducibility. Through collaboration between our component manufacturing company and Anritsu as an RF test instrument provider we aim to create a framework and environment that allows us to compete globally," says Mr. Oota.

With Anritsu's testing technology providing unparalleled support, Murata can deploy cutting-edge noise suppression solutions worldwide.

For more information about noise suppression solutions of Murata, click here:

[Noise suppression solutions compatible with the USB 3.2 RFI System-Level Test](#)

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