

# BLUETOOTH CHANNEL SOUNDING

## >>> EVAL KIT

### PRODUCT BRIEF: METIRIONIC DMK-54L

#### INTRODUCTION >>>

Bluetooth® 6.0 introduces Channel Sounding, a feature designed to enhance secure high-precision distance measurements by capturing detailed signal properties, even in the most complex high multipath environments. This capability allows for improved ranging and location accuracy, though the specification itself does not define how distances should be calculated – this is where Metirionic’s Advanced Ranging Stack (MARS) comes in. MARS is an advanced low power signal processing upper-layer software that runs seamlessly on Nordic’s nRF54L15 platform to ensure precise, reliable and real-time ranging and location accuracy for industrial, IoT, RTLS, logistics, and secure access applications. MARS can run on embedded MCUs, an external MCU or Applications Processor, or on a host PC. Whether optimizing asset tracking in warehouses, enabling accurate keyless entry, or ensuring precise navigation for automated guided vehicles, MARS is built to meet the evolving demands of modern industries.

MARS improves upon existing ranging techniques such as Round-Trip Time (RTT) and Phase-Based Ranging (PBR). RTT, while useful, is highly susceptible to multipath interference, leading to significant outliers which degrade accuracy. PBR offers improvements over RTT but struggles in reflective environments. MARS provides a superior alternative to both by leveraging the full Channel Impulse Response (CIR) for highly accurate and reliable distance estimation while leveraging minimal hardware resources at the lowest possible power consumption. MARS supports large-scale deployments and is built to adapt to future Bluetooth developments, ensuring scalability and longevity.

The DMK-54L Evaluation Kit allows developers to explore the capabilities of MARS in real-world scenarios on an industry-leading Bluetooth LE chipset. With this kit, users can measure precise distances, evaluate system performance across different environments, and experience how the potential of Channel Sounding can enrich their own products. The DMK-54L was designed to be a powerful tool for testing, validating, and enabling high accuracy ranging applications.



Picture of the Kit and Graphical User Interface

#### FEATURES AND BENEFITS >>>

- 1. Supports Bluetooth Channel Sounding:**  
MARS is integrated with the Nordic nRF54L15
- 2. Channel Impulse Response (CIR):**  
MARS uses the I/Q signal data from the nRF54L15 delivering precision accuracy even in complex multipath environments
- 3. Comprehensive Setup Tools:**  
Pre-configured firmware for both initiator and reflector ensure quick and effortless deployment
- 4. Real-Time Measurements and Visualization:**  
Windows-compatible GUI enables efficient real-time data display and analysis
- 5. Exportable Data for Analysis:**  
Captured measurement data exportable in CSV format for detailed post-processing
- 6. Versatile Testing Environments:**  
Supports indoor and outdoor setups including controlled and dynamic measurements

## MEASUREMENT RESULTS >>>

Sample measurements below provide a glimpse into both indoor and outdoor performance of MARS with the Nordic nRF54L15. MARS offers advanced error reduction delivering real-world benefits of improved accuracy, as shown in the following examples:

- > In logistics operations, reduced error rates in multipath scenarios ensure reliable asset tracking
- > In IoT applications, reduced margins of error enable smarter device positioning and enhanced functionality

Metirionic leverages a precision measurement system that runs along a controlled indoor 12-meter track, referred to as the Cable Car Tester, for repeatable testing with sub-millimeter accuracy.

Measurement Method	Mean Absolute Error (m)	Error Standard Deviation (m)	Key Observations
MARS	0.92	2.39	Superior multipath mitigation and accurate line-of-sight detection
Phase-Based Ranging (PBR)	1.28	2.65	Improved over RTT but lacks robust multipath distinction
Round Trip Time (RTT)	3.80	3.60	High susceptibility to multipath effects with significant outliers

**Table 1:** Indoor Results (12-meter Cable Car Tester)

Measurement variant	$\sigma$ / m	$2 \sigma$ / m	Max. Abs. Error / m
MARS	0.93	1.75	6.30
PBR	0.83	3.23	10.91
RTT	4.15	7.63	34.81

**Table 2:** Comparison of Distance Error Metrics for RTT, PBR, and MARS (indoor)

Measurement Method	Mean Absolute Error (m)	Error Standard Deviation (m)	Key Observations
MARS	0.87	0.94	Best performance, with minimal deviations
Phase-Based Ranging (PBR)	1.01	2.01	Moderate improvement over RTT.
Round Trip Time (RTT)	2.24	2.47	Results are stable but limited compared to PBR and MARS

**Table 3:** Outdoor Results (Line-of-Sight Environment)

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## DMK-54L KIT COMPONENTS >>>

- Two Nordic nRF54L15 development boards (pre-configured as initiator and reflector)  
**NOTE:** While the kit supports only two boards, it can be extended for additional configurations such as keyless entry and real-time location systems (RTLS). For more information on multi-node setups, please inquire further.
- Pre-flashed firmware for Bluetooth Channel Sounding and MARS
- USB cables: One cable connecting the initiator to the PC for communicating measurement results. A second cable powers the reflector, which can be connected either to a PC or to a USB power bank (not included in the kit)
- Windows-compatible GUI software for real-time visualization and analysis: The GUI offers intuitive controls for capturing, displaying, and analyzing data, allowing users to make informed decisions and quick adjustments
- Comprehensive documentation for quick setup and usage

## GET STARTED TODAY >>>

Experience the very best that Bluetooth Channel Sounding has to offer with the DMK-54L Evaluation Kit, featuring the industry leading nRF54L15 with the Metirionic Advanced Ranging Stack. Request a demo or inquire with a sales representative to begin your journey.

Visit [www.metirionic.com](http://www.metirionic.com) or email [contact@metirionic.com](mailto:contact@metirionic.com)

## ABOUT METIRIONIC >>>

Metirionic GmbH specializes in advanced wireless ranging and localization solutions, especially by enabling Bluetooth Channel Sounding for secure high-precision measurements. Based in Germany, the company develops cutting-edge technology for industrial automation, IoT, and automotive applications using Bluetooth, 15.4 and UWB radio technologies..

Metirionic's expertise in signal processing enables businesses to achieve accurate, real-time distance estimation, ensuring reliability and scalability in challenging environments.

With over a decade of pioneering research and development, Metirionic has supported customers in bringing innovative products and solutions to market. In addition, Metirionic offers a broad range of engineering and consulting services – from feasibility studies and system integration to custom software and hardware development, as well as training and support. By tailoring MARS precisely to your requirements, Metirionic ensures that their solutions are optimized for your individual needs.