BHW Technologies (博泓微科技有限公司)

RF Chips & Beyond

Advanced RF IC, Antenna, Filter, RF Front-End and Wireless System Solutions

BHW AppNote #022

Enabling Long-Range Angle-of-Arrival for High-Precision Indoor Positioning with BHWR250N RF AiA

Rev. 2.3

www.bhw-tech.com

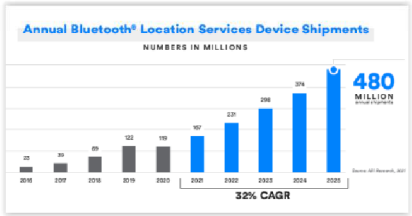
Background: AoA/AoD for Precision Indoor Positioning

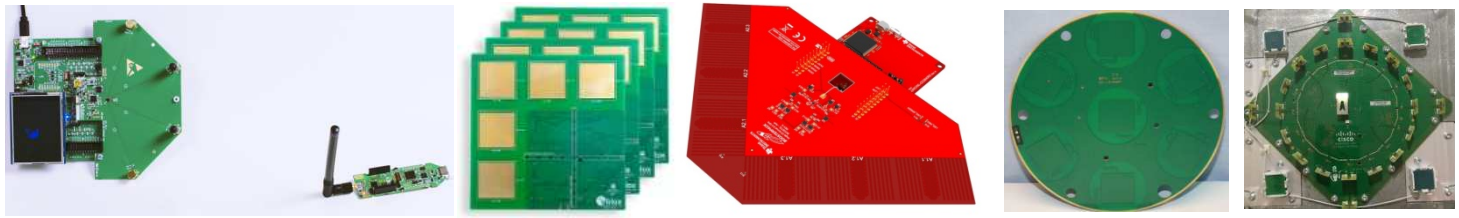
Background & Challenges:

- AoA/AoD Delivers Centimeter-Level Accuracy and is the most Promising Emerging Technology for Precision Indoor Positioning, or "Indoor GPS"
- AoA/AoD Enables Ubiquitous, Seamless Accurate Positioning of Anyone & Anything, whether Indoor or Outdoor, when Complemented by New Generation Dual/Multi-Band GNSS Solutions
- Applications Include RTLS, IPS, PoI, Item Finding, Geo-Fencing, Asset Tracking, Smart Home/Building/Factory/City, Health Care, Enhanced Shopping & Entertainment Experiences
- An Array of Multiple Antennas with Proper Spacing is Essential for Successful Deployment of AoA/AoD Systems. Mutual Coupling between Antenna Elements must be Minimized to Achieve Best-Class Performance
- Sophisticated Signal Switching and Routing in a typical AoA/AoD PCB Board Result in Excessive Losses which could Impact Performance, especially Range of Coverage

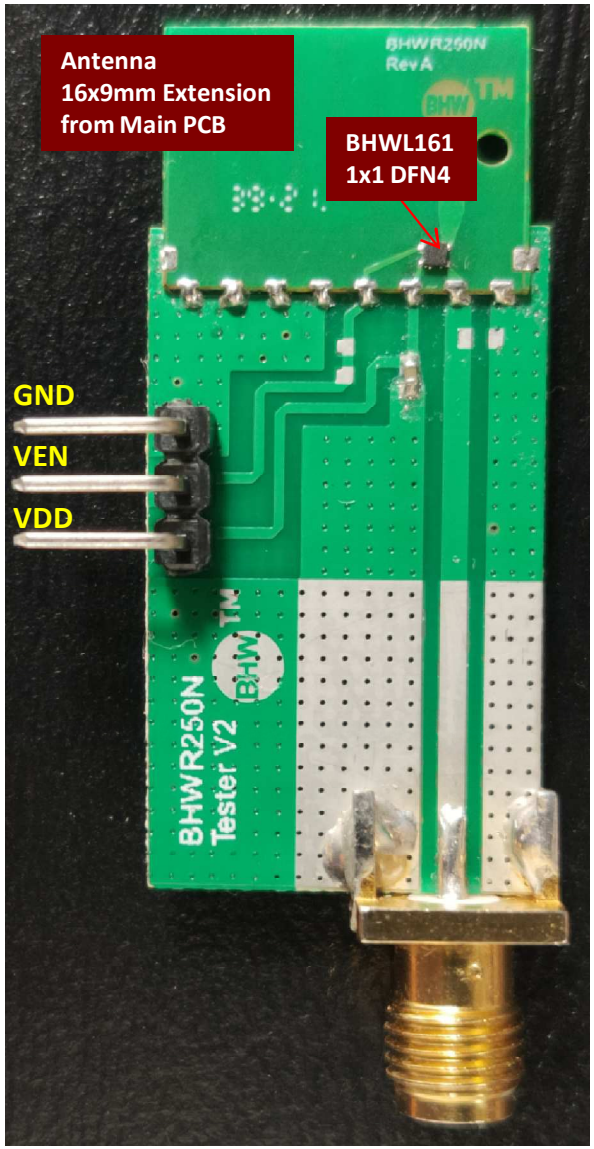
BHW Solutions & Benefits:

- Using Advanced GaAs HBT & ED-PHEMT Processes and innovative RF Active integrated Antenna (RFAiA™) Technology, BHW has Developed a Broad Portfolio of High-Performance, Cost-Effect RF Front-End ICs and Antennas for Various Wireless Applications Including the 2.4GHz Band
- BHWR250L is an AiA that Integrates an LNA with Low 1.7dB Noise Figure, a Switch Path for Single-Port Interface with any SoC, and an Antenna with High Efficiency, all into a Compact 16x12mm, Surface-Mount-Ready Design
- BHWR250M is an AiA that Integrates an LNA with 1.6dB NF, an SPDT Switch for Optional Insertion of High-Power Amplifiers, and an Antenna with High Efficiency, all into a Compact 16x12mm, Surface-Mount-Ready Design
- BHWR250N is an AiA solution tailored specifically for 2.4GHz AoA solutions, by integrating an LNA with ultra-low 1dB noise figure and a compact, high-performance antenna into a 16x12mm, Surface-Mount-Compatible Design





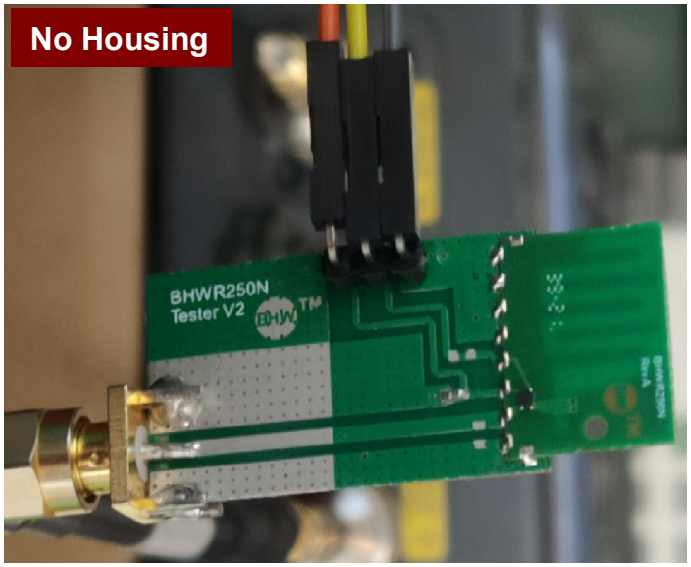
BHWR250N 2.4GHz AiA with Ultra-Low NF LNA

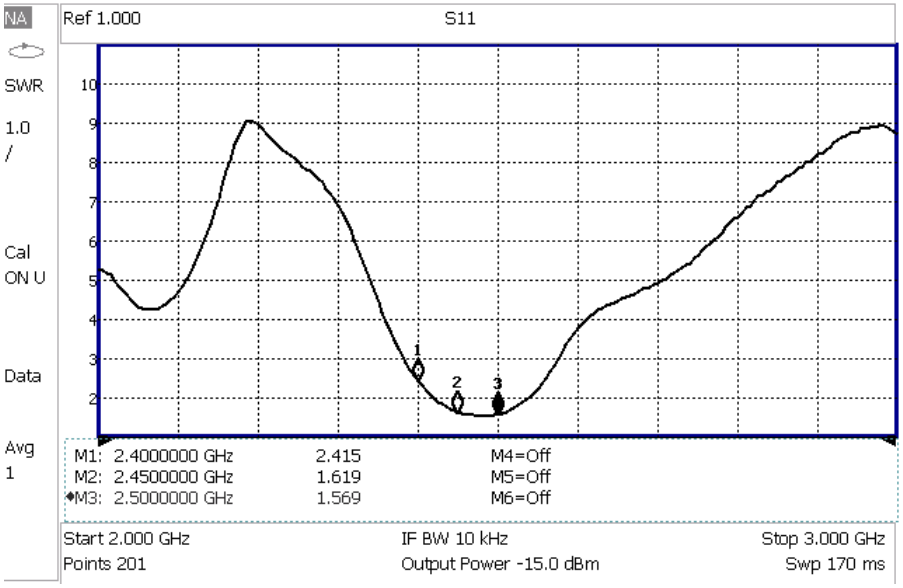


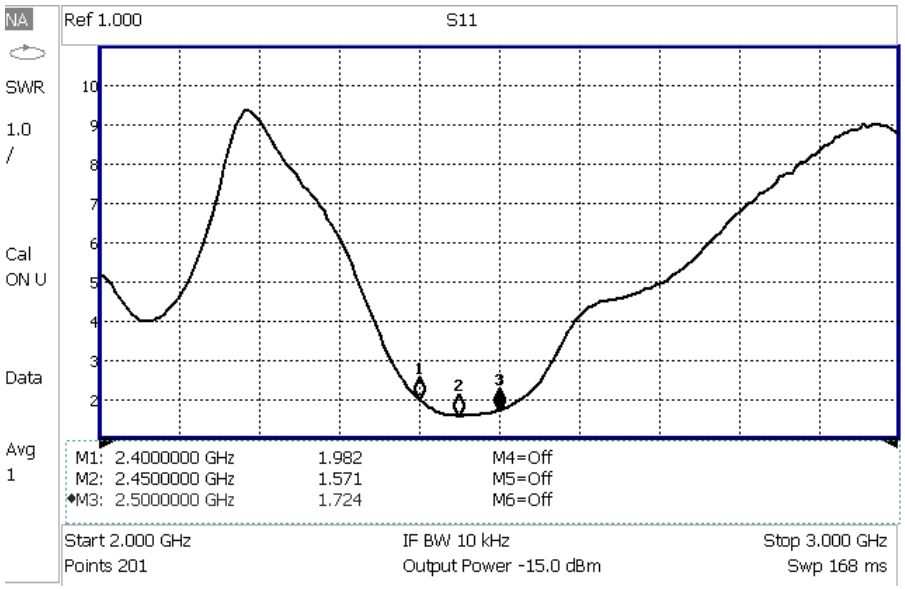
Features & Benefits:

- Innovative, Patented RF Active Integrated Antenna (RFAiA™) Architecture
- Compact Size: 16x12x0.6mm Total Size, Including Antenna and BHWL161 LNA
- Simple Surface-Mount Interface to Main Product PCB
- 12x9mm Extension from Edge of Main PCB
- No RF Design Requirement for Main PCB
- Comparable Antenna Efficiency to Much Larger Dipoles
- Industry-Leading Noise Figure: ~1.0dB at Antenna
- Low Power Consumption: ~7mA @ 3.3V Vdd
- Ultra-Low Power Operation: 2~3mA at 1.2~1.6V Vdd
- Significant Improvement in Rx Sensitivity (4~8dB)
- Significantly Improved Isolation between Antenna Elements via Synchronization of LNA & Switch Logic Control to Achieve Best-in-Class AoA Performance

BHWR250N Input VSWR and Housing Effects



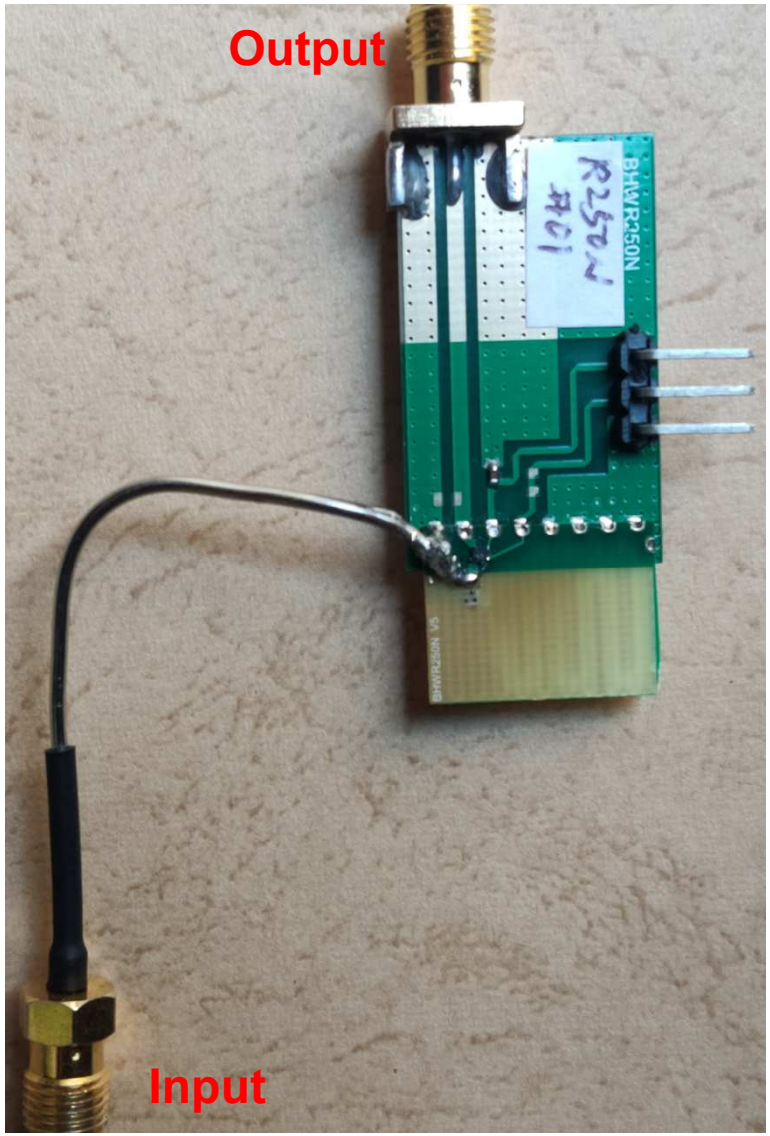




Note: EVB 18x30mm, Vdd=Ven=3.3V, Idq~7mA

BHWR250N Noise Figure Measurement Result

Test Board

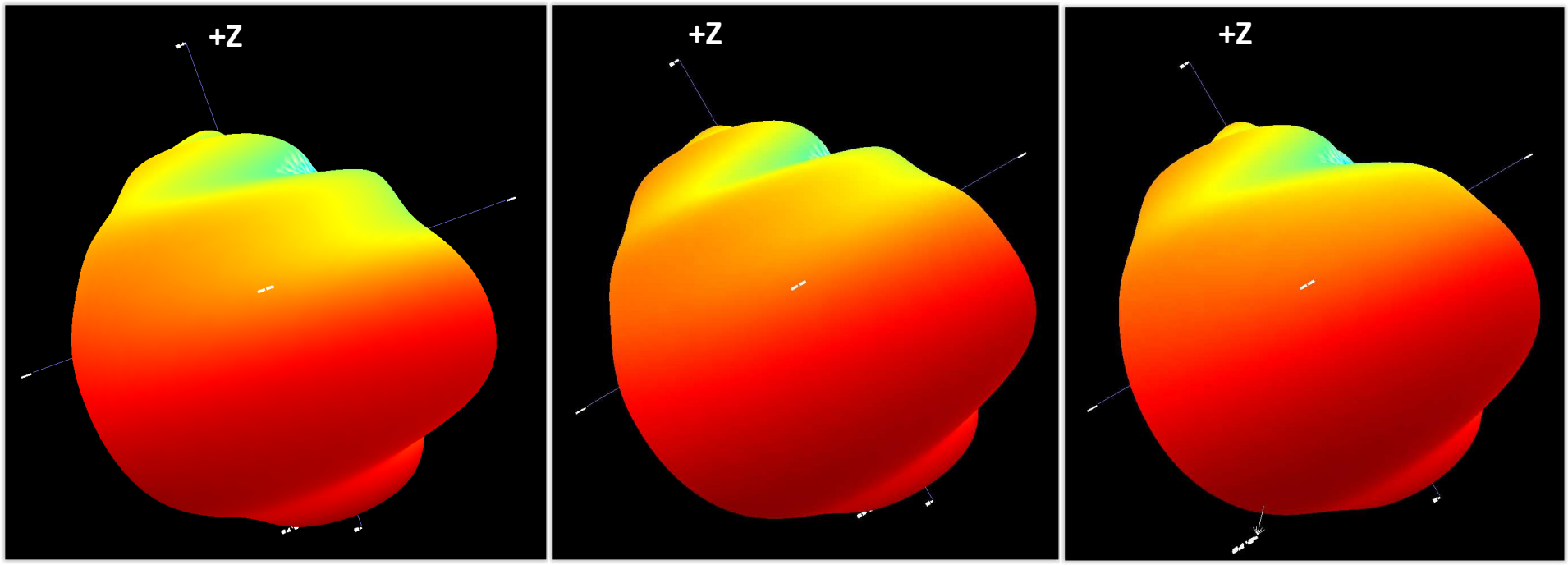


Measured NF

Notes:
-Measured with pigtail at antenna feeding point.
-DC Bias: Vdd=Ven=3.3V, Idq~7mA.
-Tested with HP 8970A NF Analyzer at 1580MHz and 0955-0635 Down-Conversion Mixer with LO=10dBm at 910MHz, corresponding to 2490MHz RF frequency.
-Measured data included SMA connector and cable losses(~0.2dB).
-Measured NF is consistent with BHWL161 EVB NF test data (~1dB at 2.45GHz).

BHWR250N Radiation Pattern: 3D Plots

BHWR250N 2400MHz	BHWR250N 2450MHz	BHWR250N 2500MHz



Note: mwShowOGL 3D plot setting: X=90. Y=210, Z=0.

BHW RF Front-End AppNote Library

This is an abridged version of BHW AppNote #022. Please contact BHW Support or your local sales rep/distributor for a complete copy of the document and other related information.

BHW RF Front-End Solutions AppNote Library

In addition to standard datasheets and EVB/BOM info, BHW publishes an AppNote series that address various topics on RF front-end design and performance over a wide frequency range from 300MHz to 6GHz, as an effort to assist customers in developing cutting-edge, cost-competitive products:

- BHW AppNote #001 - Cross-Over Cascade of BHWM253 to Boost Tx Power and Rx Sensitivity of 2.4GHz Systems
- BHW AppNote #002 - Accurate Benchmark of GNSS CN0 Using the Power-Splitter Method
- BHW AppNote #003 - Boosting Wi-Fi Tx Power and Rx Sensitivity with BHWA251 and BHWM252
- BHW AppNote #004 - UHF 900MHz RF Front-End Solution Using BHWA251 Half-Watt PA and BHWL160 Sub-1dB-NF LNA
- BHW AppNote #005 - Sub-1GHz Applications of BHWA350 2-in-1 Wideband Fully Matched Amplifier
- BHW AppNote #006 - Low-Noise High-IIP3 LNB Architecture for Dual-Band High-Precision GNSS Using Cascade of BHWL160
- BHW AppNote #007 - UWB RF Front-End Solution Using BHWA350 and BHWM552
- BHW AppNote #008 - High-Power 5.8GHz RF Front-End Solution Using BHWA555 and BHWM552 for ETC, V2X and Wireless Video
- BHW AppNote #009 - 5.8GHz RF Front-End Using BHWA350 and BHWM552 for Wireless Audio
- BHW AppNote #010 - Multi-Constellation GNSS Active Antenna Using BHWL161 Cascade and Single-Fed Dual-Band Antenna
- BHW AppNote #011 - BHWL161 Super-Compact Low-Power Low Noise Amplifier for Range Extension of 2.4GHz RC and IoT
- BHW AppNote #012 - Enabling Cost-Effective High-Precision GNSS Using BHWL161 and Linear-Polarization PCB Antenna
- BHW AppNote #013 - GNSS Noise Floor vs Receiver Architecture
- BHW AppNote #014 - Designing Ultra Low-Power High-Performance GNSS Products Using BHWL160 GaAs PHEMT LNA
- BHW AppNote #015 - BHWL161 GNSS Full-Band High-Performance LNA in Super-Compact 1x1mm DFN with Relaxed Pin Pitch
- BHW AppNote #016 - Improving GNSS NF Measurement Accuracy Using Broadband LNA BHWL161 as Pre-Amp
- BHW AppNote #017 - High-Efficiency, Low-NF 2.4GHz Front-End Solution for IoT Using BHWA251 and BHWM252
- BHW AppNote #018 - Optimizing BHWA555 Wideband One-Watt PA for Long-Range 5.8GHz Transmitter Applications
- BHW AppNote #019 - Miniature 2.4GHz RF Front-End with Integrated Chip Antenna and BHWM253 for TWS and IoT
- BHW AppNote #020 - Multiplying the Range for 2.4GHz Music Streaming with BHWR250L Active Integrated Antenna (AiA)
- BHW AppNote #021 - Range Extension for 2.4GHz Wireless Systems with BHWR250M Active Integrated Antenna (AiA)
- BHW AppNote #022 - Enabling Long-Range Angle-of-Arrival for High-Precision Indoor Positioning with BHWR250N RF AiA
- BHW AppNote #023 - Extend the Range for 5.8GHz Audio/Video Streaming with BHWR580M Active Integrated Antenna (AiA)
- BHW AppNote #024 - Improving 5.8GHz Radio Link Budget with BHWR580L Active Integrated Antenna (AiA)
- BHW AppNote #025 - Improving Range and Throughput of 2.4GHz Wi-Fi with BHWR250 Array Antenna
- BHW AppNote #026 - Improving Range and Throughput of 5GHz Wi-Fi with BHWR550 Array Antenna
- BHW AppNote #027 - Multi-Band High-Accuracy GNSS Solutions Using BHWP150 DFN1x1 Ultra-Compact Power Divider & Combiner
- BHW AppNote #028 - Use BHWM252 Cascade to Extend Range of 2.4GHz Wireless Systems with Single-Port SoCs
- BHW AppNote #029 - Improving Range of 2.4GHz Wireless Microphones and Audio Systems with BHWR250A Active Integrated Antenna (AiA)
- BHW AppNote #030 - Simultaneous Improvement in Range and Battery Life of 2.4GHz Wireless Systems with BHWR250M AiA

Contact support@bhwtechnologies.com or BHW distributors/representatives for your copy of the above and new up-coming documents.